

1. YOU MUST NOT USE YOUR LAPTOP OR YOUR CELLPHONE

(ReRead the Header information given on Study Guide 1)

SKIP Perspective (Pages 169- 188) You might find reading it useful but I will not put anything from this Chapter on the test unless it is covered in a later chapter

Chapter 19. Formation of the Solar System:

1. The earliest theories for the formation of the solar system assumed that the sun was already present and the planets formed later. This is WRONG! (The Sun and Planets formed at the same time from the same material)
2. LaPlace was the first to propose the nebular hypothesis in which the solar system formed from a contracting nebula. LaPlace understood gravity a lot better since he had the work of Newton on which to build.
3. What was the Angular Momentum problem? (The Sun rotates slowly - most of the angular momentum in the Solar System is in Jupiter)
4. The atoms in your body (except for hydrogen and helium) were formed by nuclear processes in stars.
5. The Solar Nebula Hypothesis assumes that the sun and planets were formed at the same time out of the same material but the sun formed slightly faster than the planets. This is slightly different from what is said in the textbook but more correct.
6. What is the evidence that the Solar nebula hypothesis is probably correct? (Observations of forming stars.)
7. What is an Extra-Solar planet? What physical principal (discussed in an earlier chapter) is used to find these planets? Which planets in our solar system do they resemble? (See section 19-4)
8. Remember the difference between rotation and revolution. A planet rotates on its axis and revolves around the Sun.
9. What are the facts that must be explained in order to understand the formation of our own solar system? Know the Solar System characteristics in Table 19-3.
10. What are the major similarities and differences between the inner Terrestrial planets and the outer Jovian planets? (Look at pages 410-411)
11. What is the importance of impact craters in determining the evolution of the solar system?
12. What is liquid hydrogen and metallic hydrogen? Where are they found?
13. Why are the 4 largest satellites of Jupiter called the Galilean Satellites?
14. Where are the Asteroids found? Comets? The Kuiper belt?
15. How is the age of the solar system determined? What is meant by the half-life of a radioactive element? What are some of the elements that are used to date the Solar System? (Figure 19-7)
16. Radioactive dating is used to determine the age of the solar system. The half-life is the time it takes for half of a radioactive isotope to decay into its daughter isotope. We measure the proportion of the original isotope to the daughter isotope to see how much time has passed.
17. Radioactive elements are produced in nova and supernova explosions. Possibly one went off nearby and caused the gas cloud to start collapsing into our Sun and planets.
18. What is meant by the condensation sequence of the gas in the solar nebula? (Table 19-2)
19. The planets formed in the spinning disk around the sun. Small particles condensed to form larger particles which collided to form planetesimals which collected into the proto planets. The planets closest to the sun lost most of their gas, those farther away did not.
20. Large amounts of gas from young stars is blown out into space at high speeds. This gas eventually accumulates with other gas to form new stars.
21. What is meant by differentiation of a planetary interior? The planet must be molten. Figure 19-9
22. What is meant by outgassing? How is this related to the present atmosphere of our earth? The first atmosphere?
23. Radiation pressure describes the fact that light exerts a force on gas and small particles.
24. What are the four effects for clearing the gas from the inner part of the solar nebula? (Pages 420-421)
25. The nebular theory has been confirmed by studying other solar systems and regions of space where stars are forming. (Pages 422-423)
26. The inner planets have higher densities - they are rocks and iron rich material. The outer planets are mostly thick atmosphere.
27. Asteroids and comets are the left-overs from the formation of the solar system. (The turkey on Friday the 29th).
28. There were enough asteroids and comets around in the young Solar System to fall onto the surfaces of all the planets and cause craters and reheating in some cases. We cannot see the surfaces of the outer planets but their moons (except Io) also show impacts.

29. We are searching, even as you read this, for possible large bodies that might impact the earth.
30. Deimos and Phobos are captured asteroids.
31. Our own Moon was probably caused by the impact of a large, Mars size, object with the Earth after differentiation had occurred. That is why its composition resembles the mantle and crust of the earth.
32. The latest results from the Kepler satellite is that virtually all stars that you see in the night sky have planets.

Chapter 20: Planet Earth

[Know the celestial profile for each Planet - I will not repeat this statement below]

1. What are the 4 stages of planetary evolution: differentiation, cratering, flooding, slow surface evolution? What is comparative planetology? (Figure 20-2)
2. What are the four processes that effect the geology of the earth and the other inner planets: impact craters, volcanism, plate tectonics (or its absence), and erosion.
3. What is seismology? How are pressure or p-waves and shear or s-waves used to determine the internal structure of the Earth?
4. What are the various parts of the interior of the earth and where are they located? The four layers of the Earth are the inner solid core, the liquid core, the mantle, and the crust. Why is the core thought to be iron rich material?
5. What are the heat sources in the Earth's interior? How do we know the ages of the rocks?
6. The Earth has a magnetic field that protects us from particles emitted from the Sun. What are the Van Allen Belts? How is the Earth's magnetic field like a bar magnet? What is the evidence that the direction of the magnetic field changes with time?
7. What is the relationship between the Aurorae and the Earth's magnetic field and radiation belts?
8. What is Plate Tectonics? How are the mid ocean rise and mid ocean rift connected?
9. What is a subduction zone (See pages 442-443)? What is basalt rock formed out of?
10. What mountain range is formed from the collisions of plates? (Himalayas)
11. A rift valley is formed when a crustal plate splits. Where is the crust of the earth thinnest? Thickest?
12. What will the continents look like in about 250 million years? Plates can slip along each other.
13. What is the evidence for plate tectonics and continental drift? What is a Convection Cell and how does it transfer heat from the interior to the surface? What is Magma?
14. The Hawaiian Islands are caused by a hot spot in a plate which brings magma to the surface and the overlying plate moves with respect to the hot spot. They are shield volcanoes.
15. What is the composition of the Earth's atmosphere? How is it similar to and different from other planetary atmospheres such as Mars and Venus?
16. What probably happened to Earth's first atmosphere? What is the source of our current atmosphere?
17. What is the source of the oxygen in the atmosphere?
18. What is the Greenhouse effect? What are the Greenhouse gases? Where else is the Greenhouse effect important in the solar system?
19. Our water probably came from outgassing via volcanoes and maybe the result of cometary impact.
20. Since the Earth did not freeze, the oceans could absorb carbon dioxide and reduce the amount of Greenhouse gases in the atmosphere.
21. Venus was so hot that water vapor escaped and allowed carbon dioxide to increase and produce a runaway Greenhouse effect.
22. What is meant by the Albedo of a planet?
23. What is global climate change and how is it related to the amount of carbon dioxide in the atmosphere?
24. Where is the Ozone layer located? Why is the Ozone layer important to life?
25. What human effects have changed the ozone layer?
26. How does the depletion of Ozone affect life on the earth? What causes ozone depletion?
27. The best discussion of Volcanoes can be found on pages 478-479 and I showed a number of pictures from those pages.

Chapter 21: The Moon and Mercury: Airless Worlds.

Moon:

1. The key similarity between the Moon and Mercury is their heavily cratered surfaces. Their surfaces provide a history of the early formation of the Solar System.
2. The Moon keeps the same face toward the Earth because of Tidal Coupling.
3. Where is the Terminator (the answer is not: "in California")? What is a Mare (plural is Maria)?

4. Why are the highlands on the Moon thought to be very old? And older than the Maria?
5. Read about impact craters - I went into this in some detail in class. What do the rays from some craters tell us? What and when was the Late Heavy Bombardment? (Pages 452-453)
6. Where and what is Mare Orientale?
7. Is there any evidence that impacts on the Moon blasted off rocks that fell onto the Earth? (Yes)
8. Know about the various missions to the Moon in the 1960's and 1970's. (Table 21-1)
9. All the rocks brought back to the earth are igneous - formed by the solidification of molten rock.
10. What is meant by anorthosites, breccias, regolith, vesicules? (Figure 21-5 on page 457)
11. How did we learn about the internal structure of the moon?
12. How did the Maria form? About how long ago? How do we know that they are younger than the highlands?
13. The only currently viable hypothesis for the formation of the Moon is the Large-Impact hypothesis originated by Al Cameron and collaborators. (Figure 21-9)

MERCURY:

1. How long is the Mercury Day? How does it compare to the Mercury year (Figure 21-12)?
2. What does the surface of Mercury look like? What kind of craters are found on Mercury?
3. Remember that Mercury is tidally locked to the sun but does not keep the same face to the Sun.
4. What is the Caloris Basin? How did its formation produce the jumbled terrain?
5. What caused the dark lava Plains? The Scarps?
6. What do we know about the internal structure of Mercury? It's origin and evolution?
7. We know less about the interior of Mercury because it does not have a moon and because, only recently did we have the MESSENGER satellite orbiting Mercury .
8. One of the Messenger discoveries about Mercury is that its surface shows that at one time it had a large number of volcanoes.

Chapter 22 Venus and Mars: VENUS

1. Does Venus go through phases as seen from the Earth? (Yes)
2. What is the rotation period of Venus, why is the direction of its rotation unusual? (Clockwise)
3. Why is it difficult to see the surface? What are the clouds made of? What is the composition of the Venusian atmosphere? (The most abundant molecule is carbon dioxide)
4. The high temperatures on Venus are a result of the Greenhouse effect.
5. How do we know what the surface of Venus looks like? What was the purpose of the Magellan mission?
6. The surface of Venus has both Lava Flows and rolling plains. There are lots of impact and volcanic craters on Venus.
7. Venus also has Shield Volcanoes. Where are some prominent shield volcanoes on the Earth?
8. What are Coronae? What is the evidence that Plate Tectonics does not occur on Venus?
9. Who sent landers to the surface of Mercury? What did they find?

MARS:

1. What do we know about the surface of Mars? What are the names of the various orbiters and landers?
2. What is the composition of the Martian atmosphere? How did it probably originate? Could we live on Mars without breathing apparatus?
3. What molecules were able to escape from Mars (Figure 22-13)?
4. What is the importance of the amount of argon gas in the Martian atmosphere? (It once had a thick atmosphere)
5. Does Mars have a magnetic field?
6. Mars has huge dust storms that last for months.
7. Mars has both shield volcanos and impact craters - but in different regions.
8. What is Olympus Mons?
9. What is the evidence that there were large amounts of flowing water on the surface of Mars billions of years ago?
10. What are outflow channels? Runoff channels? Where do we think the water is now?
11. What is the composition of the Martian polar caps? Are the two caps identical?
12. What do we know about the Martian meteorites?
13. What are Phobos and Deimos? They most closely resemble captured asteroids.
14. Be familiar with the material on pages 496-497.

Chapter 23: Jupiter and Saturn JUPITER

1. Jupiter is the largest planet in the solar system and the second most massive object
2. It can be considered a Failed Star - why? It radiates more heat than it receives from the Sun. What is the heat source?
3. We find Jupiter sized planets around other stars. How do we know this?
4. The Great Red Spot is a very long lived storm. Who first saw it? (Pages 508-509)
5. How does the average density of Jupiter compare to that of the Earth?
6. What is the average composition of Jupiter and Saturn? Of the atmosphere of Jupiter and Saturn? How deep do we see into their atmospheres? (Pages 508-509)
7. Jupiter is not a perfect sphere. It is oblate (flattened) because it is rotating rapidly.
8. What are the rotation periods and how fast do the winds move on Jupiter and Saturn? (Shown in class)
9. We detect radio waves from Jupiter. They are produced by what feature of Jupiter?
10. Do Jupiter and Saturn have Aurorae? (Yes)
11. What is the Io Plasma Torus? What is Io?
12. What are the Belts and Zones of the Jovian atmosphere? What are they telling us about the heat flow from the interior? Which are rising and which are falling? (Pages 508-509)
13. What happened to the Galileo Probe?
14. All the Jovian planets have rings. When were the rings of Jupiter discovered and how? (Page 517-518)
15. What is the Roche Limit? What does it have to do with Planetary Rings?
16. I discussed the Shoemaker-Levy 9 impact. Do we have any evidence that such impacts have occurred elsewhere in the Solar system? (Yes! And on Jupiter more recently)
17. What do we know about the Jovian and Saturnian interiors? What happens to hydrogen gas as the pressure increases?
18. Why do we think that Jupiter and Saturn might have dense cores since we can't see deep into the atmosphere?
19. Why does Saturn radiate more energy than receives from the Sun? (Page 519)
20. I discussed the Galilean Moons of Jupiter in some detail. They are Io, Europa, Ganymede, and Callisto. (Know Table 23-2)
21. You will need to know the distinguishing features of these moons. Why is Io so interesting? Why is Europa so important?
22. Io has a large number of erupting volcanoes. These blast sulfur into space to form the Io torus. What causes the heating that results in volcanoes on Io?
23. Europa probably has a liquid ocean underneath a thick ice layer. Why do we think this?
24. Ganymede has both old and young surface regions. The craters look like they were formed by impacts with shaved ice.
25. Callisto has cratered regions and probably an old surface. It has not suffered as much tidal heating as the other moons.
26. Are the rings of Jupiter old? (No: Page 518)

SATURN

1. Saturn is the second most massive planet and it has a lower density than Jupiter and water.
2. It also rotates rapidly, almost as rapidly as Jupiter, and so it is oblate (flattened).
3. It radiates nearly twice as much heat as it receives from the Sun. What is the source of heat for this planet? (Page 519)
4. Saturn also has a magnetic field. But it is weaker than that of Jupiter.
5. Why are the clouds of Saturn less distinct than those of Jupiter. (Methane crystal haze)
6. What is the name of the spacecraft orbiting Saturn? What was the name of the Titan lander?
7. Read about the discovery that the rings are actually particles and not solid. The pictures from the various spacecraft flybys revolutionized our understanding. For example, the Spokes seen in Voyager images. The breaking up of the rings into many smaller narrower rings. The Shepherd satellites associated with the F ring. (Pages 528-529)
8. Saturn has a lot of moons. Some are more important and interesting than others.
9. Titan is definitely known to have an atmosphere and the existence of this atmosphere has been known for sometime.
10. What are some of the organic compounds detected in the atmosphere of Titan? (Table 23-3)
11. Titan probably has a rocky core but the rest is very icy. It is larger than Mercury. There are lots of unanswered questions.
12. The Huygens lander probed the atmosphere and surface of Titan.
13. Read about the smaller moons.
14. Parts of the surface of Enceladus resemble the surface of Ganymede: cracks and new surface plus regions that are heavily cratered. Plus gas is being ejected right now.
15. How do we determine the relative ages of the moon's surfaces? (Number of craters)