

# STUDY GUIDE FOR PART 3 (Astronomy)

## The Solar System

### INTRODUCTION:

Having surveyed our course (Part 1) and built our spaceship (Part 2) we are finally ready to take off on our journey through the universe. The first part of this trip will take us around our neighborhood: the solar system.

In Section A we look back at our home base, Earth, from our new perspective from space. We will see where our seasons come from, a theory on the cause of ice ages, and where the expression "Age of Aquarius" comes from.

In Section B we look at our nearest neighbor, the only place a human has personally visited so far: the moon. We will consider its motion, its phases, and its surface features. We will also consider the moon's effect on earth: eclipses and tides.

In Section C we will deal with the major bodies of the solar system: the planets and their satellites (moons). We delay, however, discussion of the greatest body of the solar system, the sun, until Part 4 since the sun is a star and so inherently different than the rest of the solar system.

In Section D we will look at the minor bodies in the solar system: meteors, asteroids, comets.

Finally in Section E we consider theories on the origin of the solar system.

### A. THE EARTH - A CELESTIAL BODY

#### OUTLINE:

1. The orientation of the earth in space
  - a) tilt of the earth ( $23\frac{1}{2}^\circ$ ) and the seasons (MAJOR effect)
  - b) elliptical orbit of earth ( $\epsilon = .017$ ) and the seasons (MINOR effect)
  - c) precession of the equinoxes due to "wobble"
  - d) variation of the tilt - link to ice ages?
2. Time
  - a) sidereal time (with respect to the STARS)
  - b) solar time and local time (with respect to the SUN)
  - c) standard time and daylight savings time (with respect to transportation)
  - d) calendars: (one year = 365.2422 days = 365 days, 5 hours, 48 minutes, 45 sec)

#### Study Questions for Part A:

- \*1. What is responsible for the seasons? Be able to provide evidence to support your answer.
2. Why are leap years necessary?
- \*3. What is the precession of the equinoxes and how does it relate to the "Age of Aquarius" and the position of the North Star?
4. Distinguish between sidereal and solar time.
5. Distinguish between standard and local time.

## B. THE MOON - EARTH'S NEAREST NEIGHBOR

### OUTLINE:

#### 1. Basic Facts

- a) distance from the earth ( $\approx 384,000$  km or  $\approx 250,000$  miles or  $\approx 30$  x diameter of earth)
- b) size (actual:  $\approx \frac{1}{4}$  diameter of earth; angular  $\approx \frac{1}{2}^\circ$ )
- c) mass ( $.0123$  x mass of earth), gravity ( $g_{\text{moon}} = (1/6) \times g_{\text{earth}}$ ), and tides ( $\approx 2$  high tides a day)
- d) moonlight

#### 2. The Structure of the Moon

- a) atmosphere
- b) surface
  - (1) craters
  - (2) maria
  - (3) mountains
  - (4) rays
  - (5) rills
- c) interior
- d) origin of the moon

#### 3. The Motions of the Moon

- a) sidereal (27.3 days) and synodic (29.5 days) periods
- b) synchronous rotation (same face to earth!)
- c) phases (related to time of rising of moon!)
- d) eclipses : SOLAR and LUNAR
  - (1) orbital position #1: new moon and full moon
  - (2) shadows: umbra & penumbra
  - (3) orbital position #2: apogee & perigee
  - (4) time of year:  $5\frac{1}{2}^\circ$  tilt of orbit - line of nodes
  - (5) types: total, partial, and annular eclipses
  - (6) how often?

### Study Questions for Part B:

1. What is the distance from the center of the earth to the center of the moon?
- \*2. How does the earth-moon distance compare to the circumference and/or diameter of the earth?
3. Why doesn't the moon have any appreciable atmosphere?
4. What are the major surface features of the moon?
5. Why are surface features of the moon so different from those on earth?
6. Distinguish between the sidereal and synodic periods of the moon.
- \*7. How long is the synodic period of the moon?
- \*\*8. Be able to relate the phases of the moon to the time of the rising of the moon.
- \*9. Know what the umbra and penumbra are.
- \*10. Know the relation between total & annular eclipses, the umbra & penumbra, and apogee & perigee.
- \*11. What is the line of nodes and how does that affect eclipses?
- \*12. Why aren't eclipses very regular?

## C. THE SOLAR SYSTEM

### OUTLINE:

1. The Motion of the Planets
  - a) inclinations to the ecliptic
  - b) inferior planets
  - c) superior planets
  - d) sidereal and synodic periods
2. The Terrestrial Planets
  - a) Mercury
  - b) Venus
  - c) Earth & moon
  - d) Mars & Deimos, Phobos
3. The Giant Planets
  - a) Jupiter & 4 Galilean, plus smaller moons & rings
  - b) Saturn & rings & Titan, plus smaller moons
  - c) Uranus & rings & 5 moons
  - d) Neptune & Triton, Nereid plus rings
4. The other Planet(s)
  - a) Pluto & Charon
  - b) others ?

### Study Questions for Part C:

1. Distinguish between inferior and superior planets.
- \*2. Know what the following terms refer to: conjunction, opposition, eastern & western quadrature, superior & inferior conjunction, and maximum eastern & western elongation.
3. Distinguish between terrestrial and giant planets.
- \*4. List the planets in order from the sun and know their approximate distances (in A.U.) from the sun. Also, know what an A.U. is in terms of miles.
5. Which planets do the following major moons orbit:  
Moon, Io, Europe, Ganymede, Callisto, Titan, and Triton?
- \*\*6. Be able to discuss one terrestrial planet excluding the earth. This discussion should include: a) distance from the sun in AU, b) orbital period (synodic – its year AND sidereal), c) rotational period – its day, d) size relative to earth, e) mass – relative to earth, f) satellites (its moons), and g) major features.
- \*\*7. Answer Question #6 for one giant planet.
8. Choose one planet or satellite for colonization and give reasons for your choice and give concerns (problems that need to be addressed) about your choice.

## D. Comets, Meteors, and Asteroids

### OUTLINE:

1. Comets
  - a) orbits
  - b) physical characteristics: nucleus and tail
  - c) Halley's comet
  - d) the Oort cloud
2. Meteorites
  - a) meteors, meteoroids, and meteorites
  - b) physical characteristics
  - c) meteor showers
3. Asteroids
  - a) physical characteristics
  - b) the asteroid belt
  - c) Icarus and the apollo asteroids
  - d) the Trojan asteroids
  - e) others?
  - f) origin

### Study Questions for Part D:

- \*1. Distinguish between belt, Apollo, Trojan, and Icarus asteroids.
- \*2. What is the size range of the asteroids?
3. What are the structural components of a comet?
- \*4. How does the tail's direction relate to the sun?
5. What and where is the Oort cloud?
6. Distinguish between meteors, meteoroids, and meteorites.

## E. ORIGIN OF THE SOLAR SYSTEM

### OUTLINE:

1. Facts
2. Theories
  - a) catastrophic - planets are rare occurrence
  - b) evolutionary - planets are common occurrence

### Study Questions for Part E:

- \*1. What are the two main kinds of theories of the origin of the solar system?
- \*2. What does each say about the probability of other stars having planets?
3. Which theory do you consider more likely to be correct and why?

**Study TRUE/FALSE questions for all of part 3:**

(questions similar to these may appear on the test)

- \_\_\_\_\_ a) The fact that the earth orbits the sun in an elliptical orbit (rather than exactly circular) is the major cause of the seasons on the earth.
- \_\_\_\_\_ b) Summer is longer than winter (for both the northern and southern hemispheres).
- \_\_\_\_\_ c) A "day" on the moon (i.e., from noon to the next noon) is about 29½ earth days long.
- \_\_\_\_\_ d) The synodic period of the moon is longer than the sidereal period of the moon.
- \_\_\_\_\_ e) High tides are a little more than 12 hours apart.
- \_\_\_\_\_ f) Annular eclipses of the sun happen only when the moon is very near new moon phase and near perigee.
- \_\_\_\_\_ g) Triton is a major moon of Uranus.
- \_\_\_\_\_ h) Titan is a major moon of Saturn.
- \_\_\_\_\_ i) The largest asteroid discovered so far is bigger than the earth's moon.
- \_\_\_\_\_ j) A comet normally has a nucleus several kilometers in diameter, and when it gets close to the sun, it develops a coma that is several times the diameter of the earth, and develops a tail that can reach 10 A.U. long.
- \_\_\_\_\_ k) A meteor shower usually consists of grains of dust that burn brightly as they fall through the atmosphere.