

Physics 311, Fall 2008

Review III

6. The moon and Eclipses (Lecture 6, Chap 10 & 3)

6.1-2 Introduction

- a. Know the general properties of the Moon: its orbit, size, mass, density, and temperature, relative to those of the Earth.
- b. Must understand why there is no water and no atmosphere on the Moon.
- c. Must understand effects of gravity on the Earth-moon system: what is a tidal force? How does the moon's gravity affect Earth's motion? How does the Earth's gravity affect the moon's motion? (review Ex.1 and illustrations)
- d. Must know properties of the orbital and rotation motions of the moon. Must know what is the synchronous rotation and what causes it. Understand what causes the libration, and why we see 59% of the Moon's surface.
- e. Know of unmanned and manned missions to the Moon.

6.3-5 Moon's surface, interior, and rocks

- a. Must know major geological features on the Moon's surface: highlands, maria, and craters, and the difference in surface features between the Earth-facing side and far side.
- b. Must know why a large number of craters are present on the Moon but not on the Earth.
- c. Must know how maria formed, and what properties of the Moon can be deduced from observational facts of maria.
- d. Know the structure and composition of the Moon's interior, and how they are different from those of the Earth. Must know what causes moonquakes.
- e. Know how Moon's rocks are different from Earth's rocks. Know the geological history of the Moon, and how this can be learned by studying the Moon's rocks.
- f. Understand the meaning of Moon's images taken at different wavelengths.

6.6-7 Lunar phases and eclipses

- a. Must understand the Moon's orbital motion and what factors lead to the cyclic variations of the Moon's phase.
- b. Must be able to tell the phase of the moon, or times of moon rise and moon set relative to times of sun rise and sunset, in a given situation by using a diagram to show the relative positions of the Earth, Moon, and Sun.
- c. Must understand the reasons for solar and lunar eclipses.
- d. Must know around what lunar phases a solar or lunar eclipse may take place.
- e. Must understand the concept of the line of nodes. Must understand why we do not see a solar eclipse and a lunar eclipse every month. Know how often solar eclipses and lunar eclipses take place.
- f. Know what are total, partial, and penumbral lunar eclipses, and what are total, partial, and annular solar eclipses. Must know in what situations an observer can observe different kinds of eclipses.

- g. Must understand why a solar eclipse is visible only in certain areas on the Earth, whereas a lunar eclipse can be observed by people in a hemisphere. Know qualitatively how to estimate the size of shadows and durations of the eclipses.

7. Terrestrial Planets (Lecture 7; Chap 11)

7.1-3 Introduction, positions, and motions

- b. Study the data for Mercury, Venus, and Mars, in comparison with data for the Earth and moon; know the general properties of terrestrial planets in terms of size, mass, distance to the Sun, existence of atmosphere and water, and temperature and its variation.
- c. Must understand the angular positions of planets in the sky. Must know the concepts of inferior planets, superior planets, conjunctions, oppositions, and greatest western and eastern elongations.
- d. Know Kepler's first law and understand the concepts of eccentricity, perihelion, and aphelion.
- e. Must understand when are the best times to observe Mercury, Venus, and Mars from the Earth. Must understand what determines the apparent brightness of a planet, and why Venus is the brightest planet in the sky (Ex.2).
- f. Must understand the following phenomena: phases of planets and solar transit of planets. Must be able to estimate the angular size of planets at different phases.
- g. Must know the 3-to-2 spin-orbit coupling of Mercury's motion and what causes such coupling – compare this with the moon's spin-orbit motion pattern.
- h. Must know the concepts of prograde and retrograde rotations.
- i. Understand the length of a solar day on planets with certain rotation/orbit patterns.
- j. Must know the observational methods to determine the rotation velocity of a rotating planet (e.g. Ex. 6 and 7).

7.4 Atmosphere

- a. Review what conditions determine whether certain gas particles can be retained in a planet's atmosphere.
- b. Must know general properties of terrestrial atmospheres in terms of air pressure, temperature profiles, and compositions, and how they are different on Venus, the Earth, and Mars.
- c. Must know evolutions of the terrestrial atmospheres. Must know what are the runaway greenhouse effect and runaway icehouse effect, and how they affect terrestrial atmospheres.
- d. Must know how to calculate the mean surface temperature of a planet using the energy balance equation. Must understand the meaning of the terms in the energy equations.

$$P_{in} = P_{out}$$

$$P_{in} = \frac{4\pi R_s^2 \sigma T_s^4}{4\pi d^2} \pi R^2 (1 - a)$$

$$P_{out} = 4\pi R^2 \sigma T^4$$

- e. Know the atmosphere circulation patterns and seasonal variations on terrestrial planets.

7.5-7 Surface, geological activities, interior, magnetic fields, missions

- a. Must know characteristic surface features on terrestrial planets and major, if any, geological activities on these planets.
Example: mountains, basins, and channel-like features are present in all terrestrial planets. How did they form?
- b. Must know the relative ages of terrestrial surfaces and understand why. Must know what drives geological activities and why plate tectonics are present only on the Earth.
- c. Understand radar techniques to observe the surface of a planet below clouds.
- d. Must know observational evidence for past and current water on Mars.
- e. Know the interior structures of terrestrial planets and the moon. Know what planets have global magnetic fields and why. Must know methods to find out the interior structure of a planet.
- f. Know of past, current, and future missions to terrestrial planets, and what are the scientific goals in these missions.

General: Comparatively study properties of terrestrial planets: their motions, surface features, atmospheres, evolutions, and interiors. Must know how to explain the differences and similarities in the properties of these planets (see Review of Terrestrial Planets in Lecture 7).

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