Astronomy 301

HOMEWORK 2

Due Tuesday, September 22, 2015

Answer all questions in Part A, and one from Part B.

Part A answers may be given on this sheet. Part B answers should be written or typed on separate sheets of paper.

Part A

A1. List the following angles in order of *increasing* size:
46°, 200′, 4°20′, 10", and 1′

A2. If you lived on Mars, name all of the planets which would sometimes be visible as a crescent?

A3. If you stand facing the full Moon as it rises above the horizon, the Sun must be

(a) directly above you.
(b) above the horizon, on your left.
(c) above the horizon, on your right.
(d) below the horizon, in front of you.
(e) on the horizon, behind you.

A4. An eclipse of the Moon occurs at full Moon. Why is there not a total lunar eclipse at every full moon?

A5. Solar and lunar eclipses sometimes occur about 2 weeks apart. What causes the 2-week interval?

A6. Groups of eclipses occur about 6 months apart. What causes this 6-month interval?

A7. Kepler's first law (as he derived it) states that planetary orbits are

(a) ellipses with the Sun at one focus.
(b) circles with the Sun at the center.
(c) ellipses with the Sun at the center.
(d) circles with the Sun at one focus.
(e) parabolas with the Sun at one focus.

A8. Kepler's third law of planetary motion states that:

a. $P=a$ b. $P^2 = a^3$ c. $P = a^2$ d. $P^2 = a$ e. $P = a^3$

A9. In Kepler's third law, what is represented by P?

A10. In Kepler's third law, what is represented by a?

A11. You discover that a comet has an orbital period of 1000 years. What is the semimajor axis of its orbit?

a. 1,000 AU b. 10 AU c. 1 AU d. 100 AU e. 10,000 AU

A12. Some comets enter the inner solar system from a cloud far beyond the orbit of Pluto. Other comets orbit entirely inside the inner solar system (i.e. inside the orbit Pluto).

Into which class would you put a comet which orbited the Sun every 50 years? And why?

A13. Newton's law of gravity states that the force attracting two bodies depends on

(a) the product of the masses divided by the square of the distance between them.
(b) the sum of the mass divided by the distance between them.
(c) the product of the masses divided by the distance between them.
(d) the square of the product of the masses divided by the distance between them.
(e) the square of the product of the masses divided by the cube of the distance between them.

A14. If the mass of both the Earth and the Moon were tripled, how would the force of gravity between them change?

A15. The mass of the Earth is eighty-one times the mass of the Moon. How strong is the force of the Earth's pulling gravity on the Moon, compared to the Moon's pull on Earth?

(a) eighty-one times stronger
(b) nine times stronger
(c) the same
(d) eighty-one times weaker

A16. How does the amount of acceleration of the Moon towards the Earth compare to the amount of acceleration of the Earth towards the Moon?

(a) eighty-one times stronger
(b) nine times stronger
(c) the same
(d) eighty-one times weaker

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Part B

In answering the questions, imagine you are an author of a book for junior high students. Do not simply copy or paraphrase Seed's glossary. Be imaginative

B1.

a. Explain clearly and thoroughly why Galileo's observations of the phases of Venus were consistent with the Copernican model of the Solar System but quite inconsistent with the Ptolemaic model.

b. The early astronomers argued correctly that, if the Earth moves around the Sun, the nearer stars would shift in position relative to the farther stars. After careful observations, they saw no such shifts of stars relative to one another. They concluded that therefore the Earth did not move. This is, of course, incorrect.

How would **you** explain to Ptolemy the error of his ways?

B2.

a. Using your own words, review Galileo's telescopic discoveries and explain why they supported the Copernican universe and not the Ptolomaic universe.

b. Why did the Copernican hypothesis win gradual acceptance?

B3.

a. Draw and label a diagram showing the Earth, the Moon and their shadows (umbra and penumbra) during a total lunar eclipse.

Indicate on this figure one location from which the Earth and the Sun have the same angular diameter.

b. Explain clearly why many more lunar eclipses than solar eclipses can be seen from any one place on Earth?

c. How would the frequency of star and lunar eclipses be different if the Moon's orbits were not tipped with respect to the plane of the Earth's orbit around the Sun?

B4.

"It was necessary to observe the stars for many centuries, recognize in their appearances the real motions of Earth, ascend to the laws of planetary motions, and from these laws to the principle of universal gravitation, and redescend at last from this principle to the complete explanation of all celestial phenomena even in their smallest details. This is what the human mind has accomplished in Astronomy."

Pierre Simon de Laplace
1749-1827

a. What led Laplace to the extraordinary statement?

b. Neptune was discovered in 1846. Had Laplace been alive, do you think this discovery would have caused him to modify his statement?

c. The perihelion advance of Mercury's orbit led to a problem in the late 19th century. What was the problem? How do you think Laplace would have reacted to the problem?