Introductory Astronomy

Homework 12: The Moon and Mercury Not to be handed in. Homework solutions are posted already.

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022 qmult 00100 1 1 1 moderate memory: lunar tidal locking

1. The lunar month is:

   a) the same length as the lunar day due to tidal locking (i.e., tidal coupling or tidal force effects).
   b) the same length as the lunar day due to radioactivity.
   c) the same length as the lunar day due to the solar wind (i.e., solar wind interactions with the Moon's magnetic field).
   d) the same length as the lunar day due to light reflected from Earth.
   e) twice the length of the lunar day.

   SUGGESTED ANSWER: (a) I may not have used the term tidal coupling in the lectures, but people should be able to rule out the wrong answers.

   Wrong answers:
   e) No!

   Redaction: Jeffery, 2001jan01

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022 qmult 00130 2 5 5 moderate thinking: Earth seen from Moon

2. You are standing on the near side of the Moon. How does the Earth's position in the sky change relative to your local horizon?

   a) The Earth moves across sky from eastern to western horizon for a 12 hour period on average and then is below the horizon for another 12 hour period on average. The Earth does show phases that depend on the time of the lunar month.
   b) The Earth circles the zenith position every 24 hours.
   c) The Earth circles the zenith position every 29.53059 days on average.
   d) The Earth zigzags randomly all across the sky.
   e) The Earth stays more or less fixed in the sky relative to the local horizon because of the synchronous tidal locking of the Moon to the Earth. The Earth jiggles about a little because of some wobbling of the Moon. The Earth does show phases that depend on the time of the lunar month.

   SUGGESTED ANSWER: (e) See HI-136.

   Wrong answers:
   d) On the near side of the Moon, the Earth must always be above the horizon.

   Redaction: Jeffery, 2001jan01

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022 qmult 00210 2 4 2 moderate deducto-memory: two-Moon-Earth facts

3. Two immediately striking facts about the Moon in comparison to the Earth are (1) the Moon's radius is about ________ times the Earth's radius and (2) the Moon's mean density is about ________ times the Earth mean density.

   a) 1/4; 2 b) 1/4; 3/5 c) 1/2; 2 d) 2; 2 e) 1/10; 1/20

   SUGGESTED ANSWER: (b)

   Wrong answers:
   e) Both values are way too small.

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022 qmult 00220 2 1 3 moderate memory: mean lunar density

4. The mean lunar density relative to the mean Earth density is:

   a) high. b) negligible. c) low. d) identical. e) practically the same.

   SUGGESTED ANSWER: (c)

   Wrong answers:
   a) Exactly wrong.

   Redaction: Jeffery, 2001jan01

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022 qmult 00225 2 5 3 moderate thinking: Moon's gravity

5. The Moon's mass is about 1/80 of the Earth's mass. But the Moon's surface gravity is about 1/6 of the Earth's surface gravity. Why isn't the Moon's surface gravity about 1/80 of the Earth's surface gravity?

   a) The gavitational force of the Earth increases the downward gravitational force on the Moon.
   b) The gravitational force law has mass **TIMES** radius squared. The Moon has a small mass relative to Earth, but also a small radius relative to Earth. The two differences cancel somewhat, and so the Moon's surface gravity is not as small as just considering the Moon mass only suggests.
   c) The gravitational force law has mass **DIVIDED** by radius squared. The Moon has a small mass relative to Earth, but also a small radius relative to Earth. The two differences cancel somewhat, and so the Moon's surface gravity is not as small as just considering the Moon mass only suggests.
   d) Magnetic fields on the Moon increase the effect of gravity.
   e) The astronauts were too full of turkey.

   SUGGESTED ANSWER: (c)

   Wrong answers:
   a) Certainly the Earth's gravitational force effects the Moon. But this force causes the Moon and things on its surface to fall toward the Earth not to the center of the Moon. Since the Moon and the things on its surface are falling toward the Earth, they are in free-fall and weightless relative to the Earth.
   b) This could be seen to be wrong simply by recalling the gravitational force law. But it can also be deduced to be wrong. If it were mass times radius squared, then small mass and small radius would result in smaller surface gravity than 1/60 of Earth's.
   d) A red herring. The Moon doesn't have much magnetic field anyway.
   e) This is the Thanksgiving answer. It doesn't work in the spring term.

   Redaction: Jeffery, 2001jan01

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022 qmult 00230 1 1 3 easy memory: far side of the Moon

6. The far side of the Moon is:

   a) seen from Earth once per month. b) seen from Earth only at new moon. c) never seen from Earth. d) seen from Earth only during solar eclipses. e) constantly visible from Earth.

   SUGGESTED ANSWER: (c)

   Wrong answers:
   e) Exactly wrong.

Redaction: Jeffery, 2001jan01

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022 qmult 00240 1 4 1 easy deducto-memory: lunar sky

7. The sky on the Moon is always:

   a) black. b) blue. c) red. d) red and white. e) red, white, and blue.

   SUGGESTED ANSWER: (a) The Moon has virtually no atmosphere. Hence the light from astonomical sources will not be scattered about. The surface is be brightly illuminated during the day, but the sky still looks black and stars can be seen???. Well maybe not. They are as bright as at night, but eyes or cameras adjusted to bright conditions may not be able to see them.

   Wrong answers:
   b) Nah, nah, that's the Earth.
   c) True the Soviets did send the first probes around the Moon and to its surface.
   d) Canada has no lunar specialities.
   e) "Hurrah for the red, white, and blue, da da dada, da da dada"—John Philip Sousa forever.

   Redaction: Jeffery, 2001jan01

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022 qmult 00300 1 1 2 easy memory: the lunar maria

8. A mare (Latin for "sea": the last "e" is not silent but the pronunciation seems various and who knows how the Romans really said it: plural "maria") is:

   a) a region of the light colored lunar highlands.
   b) a dark lava plain on the Moon that is **LIGHTLY** cratered compared to the lighter colored lunar highlands.
   c) a dark lava plain on the Moon that is **HEAVILY** cratered compared to the lighter colored lunar highlands.
   d) a sea bed of a dried up lunar sea.
   e) the mother of a colt.

   SUGGESTED ANSWER: (b) Sea bed or seabed? Barnhart (Ba-1092) fails me.

   Wrong answers:
   e) Not the best answer in the context of this course or this question.

   Redaction: Jeffery, 2001jan01

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022 qmult 00310 2 1 5 moderate memory: the lunar mountains

9. The lunar mountains seem to be

   a) fold- and fault-mountains, impact crater rims or parts thereof, and hotspot volcanoes.
   b) fold- and fault-mountains and hotspot volcanoes.
   c) fold- and fault-mountains.
   d) impact crater rims or parts thereof and hotspot volcanoes.
   e) entirely impact crater rims or parts thereof.

   SUGGESTED ANSWER: (e)

   Wrong answers:
   c) Large fold- and fault-mountain chains require plate tectonics although smaller scale ones may exist on Venus which doesn't seem to have any plate tectonics.

   Redaction: Jeffery, 2001jan01

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022 qmult 00500 1 1 4 easy memory: moonquake definition

10. A moonquake is:

a) a wobble of the Moon in its orbit. b) a lunar mare. c) a fluctuation in the Moon's reflected brightness caused by a strong gust of the solar wind. d) the Moon's equivalent of an earthquake. e) a contradiction in terms.

SUGGESTED ANSWER: (d)

Wrong answers:

e) No its not. A Moon earthquake is a contradiction in terms.

Redaction: Jeffery, 2001jan01

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022 qmult 00600 2 1 4 easy memory: moonquake cause

11. Most significant moonquakes (in the present epoch) are thought to be caused primarily by:

a) plate tectonic activity. b) volcanism. c) impacts and volcanism. d) impacts and solar tidal force effects. e) the solar wind.

SUGGESTED ANSWER: (d) Most people should know that geological activity like plate tectonics and volcanism (which on Earth is usually associated with plate tectonics) don't happen on the modern moon.

See FK-218–219: they discuss tidal force and impact moonquakes. The landslide moonquakes must occur too, but they may often not be independent events: i.e., they may be induced by impact or tidal force moonquakes usually. However, a few independent landslide moonquakes probably do occur. The expansion and contraction of rock during the daily heating and cooling cycle can probably induce landslides and concomitant moonquakes sometimes.

Wrong answers:

e) The solar wind seems unlikely now doesn't it.

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022 qmult 00800 3 1 3 hard memory: giant impactor formation of Moon

12. The giant impactor theory of the Moon's formation explains:

a) the heavy cratering of the Moon, the lunar maria, and the inclination of the Earth's axis.
b) the relatively low uncompressed mean density of the Moon compared to that of the Earth and the existence of the lunar maria.
c) the relatively low uncompressed mean density of the Moon compared to that of the Earth and the similar composition of the Earth and lunar crusts and mantles.
d) the relatively low uncompressed mean density of the Moon compared to that of the Earth and the length of the lunar month.
e) the heavy cratering of the Moon, the lunar maria, and the chemical differentiation of the lunar material.

SUGGESTED ANSWER: (c) See Se-418 for estimated uncompressed densities. The uncompressed densities are a more direct measure of the composition. I think the uncompressed densities can be estimated without specifying the composition to fully and so using them isn't entirely circular.

Wrong answers:

e) These is explained by the heavy bombardment and the internal heat of the Moon.

Redaction: Jeffery, 2001jan01

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022 qmult 00900 1 5 5 easy thinking: lunar crater age

13. How can one tell if a large lunar crater is comparatively old or young?

a) An old crater has dry water channels flowing from the rim both outward to the surroundings and inward toward the crater center. Young craters formed after all the lunar water was gone and so have no dry water channels.
b) The older the crater, the more ice has accumulated in the crater center. The ice comes from water vapor that is released by comet impacts. The ice condenses in the cold crater centers. There have probably been hundreds of comet impacts since geological activity stopped on the Moon. The ice is **EASILY SEEN** from the Earth because of its high reflectivity.
c) The older the crater, the more ice has accumulated in the crater center. The ice comes from water vapor that is released by comet impacts. The ice condenses in the cold crater centers. There have probably been hundreds of comet impacts since geological activity stopped on the Moon. The ice is covered by regolith and is **NOT EASILY SEEN** from the Earth. The ice was detected in the 1990's by radar techniques and by studying the speed of neutron emission from the lunar surface. (Energetic solar wind particles cause the lunar surface to emit neutrons.)
d) The older the crater, the greener it looks.
e) The older the crater, the more heavily it itself tends to be cratered.

SUGGESTED ANSWER: (e) The right answer is pretty clearly right although there are other ways of differentiating old and young craters. See Se-446 and Se-448.

Wrong answers:

a) No evidence exists for there ever being flowing water on the Moon.
b) There some evidence for ice on the Moon from comet impacts (though I'm guessing with the hundreds number), but it is only suspected in polar craters where the Sun never shines: i.e., polar craters. Thus having ice is not an evidence of age. The ice is not visible from Earth. In fact, in 2003nov, it was reported that the best radar analysis suggested there couldn't be a lot of ice. A little ice was still possible.
c) Same remarks as for (c), except that the discovery of the ice is I think as described, but I havn't check the details in detail.
d) The green cheese model of the Moon is defunct.

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022 qmult 01200 2 1 4 moderate memory: regolith

14. Lunar regolith is:

a) lunar rock ground down to fragments and dust by volcanic action.
b) lunar rock ground down to fragments and dust by strong winds present on the early Moon.
c) lunar rock ground down to fragments and dust by the solar wind.
d) lunar rock ground down to fragments by meteoritic impacts, and on the surface few meters to dust. The dust is due mainly to the sandblasting effects of micrometeorites.
e) lightly cratered lunar terrain.

SUGGESTED ANSWER: (d) But I think the answer is deduceable too at least from the longest-answer-is-the-right-answer rule. Se-452, none too clearly, says the regolith is the dust or lunar soil, not the larger fragments. The other books, even Lewis, p. 386 are equivocal. See HI-142.

Wrong answers:

a) Volcanic action has long stopped on the Moon. Sometimes it creates soot powder though I think.
b) Maybe plausible, but no one has talked about strong lunar winds.
c) The Solar wind is atomic. I don't think it can pulverize.
e) This may sound plausible.

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022 qmult 01310 2 4 1 moderate deducto-memory: roundness and cratering

15. Until about the middle of the 20th century most geologists thought the lunar craters were mostly volcanic. This was so because it was thought that impact craters:

a) could not be mostly so round as almost all lunar craters appeared to be.
b) had to be mostly so round as almost all lunar craters appeared to be.
c) could not be on top of mountains as almost all lunar craters appeared to be.
d) had to be on top of mountains as almost all lunar craters appeared to be.
e) had to be squarish unlike lunar craters.

SUGGESTED ANSWER: (a) A somewhat convoluted sentence, but it works. See FMW-173

Wrong answers:
b) This answer gives a fact that contradicts the conclusion it was meant to prove. No doubt Aristotle has a name for this logical fallacy.

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022 qmult 01400 2 4 4 moderate deducto-memory: first humans on the Moon

16. Astronauts first landed on the Moon in:

a) 1962. b) 1984. c) 1958. d) 1969. e) 1948.

SUGGESTED ANSWER: (d) A super easy question, except for those students who regard the lunar landings in the same category Lindbergh's trans-Atlantic solo flight: i.e., one with Nineveh and Tyre.

Wrong answers:
c) Great year. Superb vintage and all that.

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022 qmult 01600 2 4 4 moderate deducto-memory: crewed lunar landing period

17. The time period of the crewed lunar landings was:

a) 1962–1972. b) 1984–1992. c) 1958–1962. d) 1969–1972. e) 1948–1958.

SUGGESTED ANSWER: (d) A moderate deducto-memory question, except for those students who regard the lunar landings in the same category Lindbergh's trans-Atlantic solo flight: i.e., one with Nineveh and Tyre.

Wrong answers:
c) Great period. Superb vintage and all that.

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022 qmult 01900 1 4 4 easy deducto-memory: fate of the Moon

18. In future gigayears, the Moon:

a) will have an eventful history with volcanism and outgassing. It will develop a dense CO_2 atmosphere and become like Venus is today.
b) will split into tiny fragments and become a ring around the Earth. The ring will be rocky, and so less bright than Saturn's icy ring.
c) will crash into the Earth. This will probably end life on Earth.
d) will continue to suffer slow meteoritic erosion and occasionally large impacts. It's appearance will probably change only slowly and it might look roughly much the same as it does now when the Sun in one of its red giant phases, perhaps, swallows and evaporates it along with the Earth.
e) will turn into green cheese finally and become Santa's new home after the north polar cap melts.

SUGGESTED ANSWER: (d)

Wrong answers:
e) This is the Christmas answer.

Redaction: Jeffery, 2001jan01

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023 qmult 00100 1 1 3 easy memory: Mercury closest to Sun
19. Mercury is:

a) the largest rocky (or terrestrial) planet. b) the least cratered rocky (or terrestrial) planet. c) the closest planet to the Sun. d) always the brightest planet visible from the Earth. e) the red planet.

SUGGESTED ANSWER: (c) This is super-easy.

Wrong answers:
e) The red planet is Mars.

Redaction: Jeffery, 2001jan01

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023 qmult 00210 1 4 2 easy deducto-memory: Mercury's size
20. Among the rocky (or terrestrial) planets, Mercury is:

a) largest. b) smallest. c) most massive. d) farthest from the Sun. e) reddest.

SUGGESTED ANSWER: (b) I think Pluto must be counted as an icy-rocky body, not a rocky body.

Wrong answers:
e) Mars is reddest by most standards.

Redaction: Jeffery, 2001jan01

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023 qmult 00220 1 4 3 easy deducto-memory: Mariner 10 to Mercury
21. The only spacecraft through year 2004 to obtain close-up images of Mercury is:

a) Apollo 11. b) Apollo 13. c) Mariner 10. d) Venus. e) Mars.

SUGGESTED ANSWER: (c)

Wrong answers:
a) The Apollos were the crewed Moon missions.
d) This is a planet.
e) This is a planet too.

Redaction: Jeffery, 2001jan01

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023 qmult 00240 1 4 1 easy deducto-memory: nonsynchronous tidal locking

22. "Let's play *Jeopardy*! For \$100, the answer is: This solar system body is nonsynchronously tidally locked to the parent body it orbits."

    What is ____________, Alex?

    a) Mercury b) the Moon c) Io d) Charon e) Lead

    SUGGESTED ANSWER: (a)

    Wrong answers:

    b) The Moon is synchronously tidally locked to the Earth.
    c) Io is synchronously tidally locked to Jupiter
    d) Charon is synchronously tidally locked to Pluto and in addition Pluto is synchronously tidally locked to Charon (Cox-297, 305, 308).
    e) Lead is a dense metal. Mercury in another context is a dense metal too. But under Earth surface conditions Mercury is a liquid which is a unique condition for a metal (Cl-52,53).

    Redaction: Jeffery, 2001jan01

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023 qmult 00250 2 5 2 moderate thinking: Mercurian day

23. The ratio of Mercury's rotation period (period for one axis rotation) to its revolution period (period for one orbit around the Sun) is 2/3. Both these periods are relative to the fixed stars and both are counterclockwise when view from the north ecliptic pole. How long is Mercury's day (i.e., noon to noon period) in units of its revolution period? **HINT:** An orbital diagram with artifical mountain on Mercury might help.

    a) 1 revolution period. b) 2 revolution periods. c) 3 revolution periods. d) 1/2 revolution period. e) 1/3 revolution period.

    SUGGESTED ANSWER: (b)

    Wrong answers:

    a) This would be true with synchronous tidal locking, but Mercury is nonsynchronously tidally locked to the Sun.

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023 qmult 00260 3 5 3 hard thinking: planet day in general

24. Have you ever wondered how you calculate the length of a planet's day given its revolution (or orbital) period and axial rotation period (i.e., axial rotation period relative to the fixed stars)? "Yes!" This your lucky day.

    The easiest way to understand and set up the problem is take the origin on the planet and then the Sun revolves around the planet. Imagine line from the origin to the Sun and another line from the origin through a mountain on the planet. Take counterclockwise as the positive direction in the diagram you should have drawn by now. First, align the lines and then let time advance. When the lines come back into alignment, one planet day has passed. **HINT:** Draw a diagram.

    Mathematically, one can relate the planet and Sun rotation rates and the time of one day for cases where the axial tilt from the perpendicular to the orbital plane is not extreme by

$$360^\circ = (\omega_{\rm pl} - \omega_\odot)t \ ,$$

where $\omega_{\rm pl}$ is the planet angular rotation rate, $\omega_{\odot}$ is the Sun angular rotation rate, and

$$t = \begin{cases} \text{planet day} & \text{if } \omega_{\rm pl} - \omega_{\odot} \geq 0; \\ -\text{planet day} & \text{if } \omega_{\rm pl} - \omega_{\odot} < 0. \end{cases}$$

The peculiar definition of t allows a compact general expression. Now

$$\omega_{\rm pl} = \frac{360^\circ}{P_{\rm pl}} \qquad \text{and} \qquad \omega_{\odot} = \frac{360^\circ}{P_{\odot}} \ ,$$

where the P's are not periods, but periods multiplied by $+1$ for counterclockwise rotation and -1 for clockwise: this peculiar definition of the P's also allows a compact general expression.

Find the general formula for t in terms of $P_{\rm pl}$ and $P_{\odot}$. What happens if $|P_{\rm pl}| << |P_{\odot}|$? What happens if $P_{\rm pl} = P_{\odot}$?

a) The general formula is

$$t = \frac{P_{\odot} - P_{\rm pl}}{P_{\odot} P_{\rm pl}} \ .$$

If $P_{\rm pl} << P_{\odot}$, then $t \approx 1/P_{\rm pl}$ and the day is the inverse of the rotational period. If $P_{\rm pl} = P_{\odot}$, the day is zero time in length.

b) The general formula is

$$t = P_{\rm pl} - P_{\odot} \ .$$

If $P_{\rm pl} << P_{\odot}$, then the day is negative and time flows backward. If $P_{\rm pl} = P_{\odot}$, the day is zero time in length.

c) The general formula is

$$t = \frac{P_{\odot} P_{\rm pl}}{P_{\odot} - P_{\rm pl}} \ .$$

If $P_{\rm pl} << P_{\odot}$, then $t \approx P_{\rm pl}$ and the day is almost the same length as the rotation period. If $P_{\rm pl} = P_{\odot}$, the day is infinitely long and the planet is synchronously tidally locked to the Sun.

d) The general formula is $t = P_{\rm pl}$ since the day always the same length as the planet rotation period. If $P_{\rm pl} << P_{\odot}$ or $P_{\rm pl} = P_{\odot}$, then still one has $t = P_{\rm pl}$.

e) The general formula is $t = P_{\odot}$ since the day always the same length as the Sun rotation period. If $P_{\rm pl} << P_{\odot}$ or $P_{\rm pl} = P_{\odot}$, then still one has $t = P_{\odot}$.

SUGGESTED ANSWER: (c)

Behold

$$\begin{aligned} t &= \frac{360^\circ}{\omega_{\rm pl} - \omega_{\odot}} \\ &= \frac{1}{1/P_{\rm pl} - 1/P_{\odot}} \\ &= \frac{P_{\odot} P_{\rm pl}}{P_{\odot} - P_{\rm pl}} \qquad = \frac{P_{\rm pl}}{1 - P_{\rm pl}/P_{\odot}} \ . \end{aligned}$$

If $|P_{\rm pl}| << |P_{\odot}|$, then

$$t \approx P_{\rm pl} \left(1 + \frac{P_{\rm pl}}{P_{\odot}} \right) \approx P_{\rm pl} \ ,$$

where the first expression uses the power series expansion (Ar-238) which students don't really need to know: but if they did they would be so enlightened. The upshot is that planet day is going to be very nearly the planet rotation period. This is the case for Earth and Mars for example, but not Mercury and Venus.

If $P_{\rm pl} = P_\odot$, the day is infinite. In this case the planet is synchronously tidally locked to the Sun. There are no such planets in the solar system.

Note that if t is positive, the mountain line moves positively with respect to the Sun line and from the perspective of an observer on the planet, the Sun moves west on the sky. This is, of course, the case for Earth. If t is negative, then the mountain line moves negatively with respect to the Sun line and from the perspective of an observer on the planet, the Sun moves east on the sky. This is the case for Venus for example.

If one sketches t as a function of $P_{\rm pl}$, one gets a function with two domains. For $P_{\rm pl} < P_\odot$, the function rises monotonically from an asymptotic $-P_\odot$ at $P_{\rm pl} = -\infty$ to 0 at $P_{\rm pl} = 0$ to ∞ at $P_{\rm pl} = P_\odot$. Then for $P_{\rm pl} > P_\odot$, the function rises monotonically from $-\infty$ at $P_{\rm pl} = P_\odot$ to an asymptotic $-P_\odot$ at $P_{\rm pl} = \infty$. The derivative of t with respect to $P_{\rm pl}$ is

$$\frac{dt}{dP_{\rm pl}} = \frac{P_\odot^2}{(P_\odot - P_{\rm pl})^2}$$

which is always greater than zero where defined and proves that the function rises monotonically everywhere, except at $P_{\rm pl} = P_\odot$ where the function is formally undefined.

All these complications come from working with time periods. If we simply work with rates, then relative rate of the the Sun in the sky is just $\omega_{\rm pl} - \omega_\odot$ and

$$t = \frac{360^\circ}{\omega_{\rm pl} - \omega_\odot} \ .$$

But the time periods are what are usually reported and discussed.

Wrong answers:
b) Ha, you are guessing at the simplest formula.

Redaction: Jeffery, 2001jan01

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023 qmult 00400 1 4 4 easy deducto-memory: Mercury's atmosphere
25. Mercury has:

a) a thick, dry, carbon dioxide atmosphere.
b) a water vapor atmosphere which is thick enough to to cause clouds that are sometimes seen from Earth.
c) a thin, but nearly breathable, oxygen-nitrogen atmosphere.
d) almost no atmosphere.
e) a thick atmosphere of nearly transparent molecular hydrogen gas.

SUGGESTED ANSWER: (d) Well the longest-answer-is-the-right-answer rule fails here. Everyone who has read the book, been to the lectures, or has reasonable general knowledge knows that Mercury is almost airless. It can't be said to be completely airless, because an extremely tenuous atmosphere does exist, that has practically no effect on anything.

Wrong answers:
e) Well no.

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023 qmult 00410 1 4 1 easy deducto-memory: Mercury's lava plains

26. Mercury has lava plains somewhat like the Moon's maria, but these Mercurian plains:

    a) are not so dark and noticeable. b) cover all the Mercurian impact craters. c) are very much darker than the lunar maria. d) are green. e) are green because they are covered with vegetation.

    SUGGESTED ANSWER: (a) See Se-460–461.

    Wrong answers:

    e) Mercury is barren.

    Redaction: Jeffery, 2001jan01

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023 qmult 00500 2 4 2 moderate deducto-memory: weird terrain

27. "Let's play *Jeopardy*! For $100, the answer is: The focusing of siesmic waves at the antipodal point from Caloris Basin impactor impacted on Mercury is believed to have caused this geological feature at the antipodal point."

    What is ____________, Alex?

    a) an impact basin b) jumbled weird terrain, Alex? c) a lobate scarp d) a normal scarp e) a magnetic field

    SUGGESTED ANSWER: (b)

    Wrong answers:

    a) Contact force: no way.

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