

**Introductory Astronomy****NAME:**

**Homework 12: The Moon and Mercury:** Homeworks and solutions are posted on the course web site. Homeworks are **NOT** handed in and **NOT** marked. But many homework problems (~ 50–70%) will turn up on tests.

**Answer Table**

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1. Did you complete reading-homework-self-testing for the Introductory Astronomy Lecture (IAL) by the weekly due date?
  - a) YYYessss!
  - b) Jawohl!
  - c) Da!
  - d) Sí, sí.
  - e) OMG no!
2. 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.
3. The mean lunar month (i.e., the period from new moon to new moon) is 29.53059 days. The Moon is synchronously tidally locked to the Earth. How long is the **DAYLIGHT PERIOD** of the Moon's day at any point on the Moon? **HINT:** A diagram might help.
  - a) 29.53059 days.
  - b) about 14.8 days.
  - c) about 29 days.
  - d) 12 hours.
  - e) about 365.25 days.
4. 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.
5. 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
6. The mean lunar density relative to the mean Earth density is:
  - a) high.
  - b) negligible.
  - c) low.
  - d) identical.
  - e) practically the same.
7. 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 gravitational 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.
8. 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.
9. The sky on the Moon is always:
  - a) black.
  - b) blue.
  - c) red.
  - d) red and white.
  - e) red, white, and blue.

10. The geology of the Moon is quite different than that of the Earth. There is **NO** evidence that there is or ever was \_\_\_\_\_ and \_\_\_\_\_.
- water and wind erosion; volcanism
  - impact erosion; plate tectonics
  - impact erosion; volcanism
  - water and wind erosion; plate tectonics
  - glaciation; volcanism
11. Mare is Latin for “sea”: the last “e” is not silent, but the pronunciation seems various—mar-ray may be closest—and who knows how the Romans really pronounced it. The plural form maria is more commonly used, often as if it were a singular. A lunar mare is:
- a region of the light colored lunar highlands.
  - a dark lava plain on the Moon that is **LIGHTLY** cratered compared to the lighter colored lunar highlands.
  - a dark lava plain on the Moon that is **HEAVILY** cratered compared to the lighter colored lunar highlands.
  - a seabed of a dried up lunar sea.
  - the mother of a colt.
12. “Let’s play *Jeopardy!* For \$100, the answer is: They constitute the original lunar crust that formed during the chemical differential phase of the Moon’s formation. They are made of relatively light colored anorthosite rock. Since formation they have been heavily modified by impact erosion by impactors of all sizes. Most of the erosion happened early on in the first billion years of the Moon’s history.”
- What are the lunar \_\_\_\_\_, Alex?
- maria
  - highlands
  - lowlands
  - seas
  - craters
13. The lunar mountains seem to be:
- fold- and fault-mountains, impact crater rims or parts thereof, and hotspot volcanoes.
  - fold- and fault-mountains and hotspot volcanoes.
  - fold- and fault-mountains.
  - impact crater rims or parts thereof and many hotspot volcanoes.
  - mainly impact crater rims and parts thereof. There are also central crater peaks and some lunar domes (a kind of shield volcano).
14. A moonquake is:
- a wobble of the Moon in its orbit.
  - a lunar mare.
  - a fluctuation in the Moon’s reflected brightness caused by a strong gust of the solar wind.
  - the Moon’s equivalent of an earthquake.
  - a contradiction in terms.
15. Most significant moonquakes (in the present epoch) are thought to be caused primarily by:
- plate tectonic activity.
  - volcanism.
  - impacts and volcanism.
  - impacts and solar tidal force effects.
  - the solar wind.
16. The current favored theory for the formation of the Moon is the:
- co-accretion theory.
  - tidal coupling theory.
  - capture theory.
  - fission theory.
  - giant impactor theory.
17. The giant impactor theory of the Moon’s formation explains:
- the heavy cratering of the Moon, the lunar maria, and the inclination of the Earth’s axis.
  - the relatively low uncompressed mean density of the Moon compared to that of the Earth and the existence of the lunar maria.
  - 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.
  - the relatively low uncompressed mean density of the Moon compared to that of the Earth and the length of the lunar month.
  - the heavy cratering of the Moon, the lunar maria, and the chemical differentiation of the lunar material.
18. 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.
19. Lunar regolith is lunar rock ground down to fragments and dust by:
- a) volcanic action.
- b) strong winds present on the early Moon.
- c) the solar wind.
- d) space weathering (mainly micrometeoritic impacts and fragmentation by the diurnal temperature cycling).
- e) the cosmic microwave background (CMB).
20. 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.
21. Astronauts **FIRST** landed on the Moon in:
- a) 1962.    b) 1984.    c) 1958.    d) 1969.    e) 1948.
22. In future gigayears, the Moon:
- a) will have an eventful history with volcanism and outgassing. It will develop a dense CO<sub>2</sub> 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 space weather and occasionally large impacts. The Moon's appearance will probably change only slowly and it might look roughly much the same as it does now when the Sun in its red giant phase or its asymptotic giant branch (AGB) phase envelops and vaporizes the Moon along with the Earth.
- e) will turn into green cheese finally and become Santa's new home after the north polar cap melts.
23. 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.
24. Among the rocky (or terrestrial) planets, Mercury is:
- a) largest.    b) smallest.    c) most massive.    d) farthest from the Sun.    e) reddest.
25. "Let's play *Jeopardy!* For \$100, the answer is: This Solar System body has 3:2 spin-orbit resonance (i.e., rotates 3 times relative to the fixed stars for every two orbits) due to complicated gravitational effects."  
What is \_\_\_\_\_, Alex?

- a) Mercury    b) the Moon    c) Io    d) Charon    e) Lead
26. Based on the theory of planet formation we would expect Mercury to be richer in **RELATIVE** iron abundance than:
- a) Jupiter, but not Earth.    b) icy planetesimals, but not Earth.    c) Earth.    d) Earth, but not the Sun.    e) Mars, but not the Sun.
27. 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.
28. 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.
29. "Let's play *Jeopardy!* For \$100, the answer is: The focusing of seismic 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    c) a lobate scarp    d) a normal scarp  
 e) a magnetic field
30. Features that are prominent on Mercury, but are comparatively small and inconspicuous on the Moon, are:
- a) giant lava-flooded impact basins such as the Orientale Basin.    b) geysers.    c) impact craters of tens of kilometers in diameter.    d) lobate scarps that can stretch over hundreds of kilometers.    e) volcanic craters.
31. The rotational period of Mercury was measured in 1965 by reflecting a radio pulse with a range of frequencies (i.e., a frequency band) off of Mercury's surface. But what physical effect allows the measurement of rotation from the reflection of a radio pulse that is sent with a particular intensity and frequency band?
- a) The time interval for a pulse to return increases as a planet's rotation increases.  
 b) The intensity of a returning pulse decreases as a planet's rotation rate increases. This is caused by the Doppler effect.  
 c) The width of the frequency band of a returning pulse increases as a planet's rotation rate increases. This is caused by the Doppler effect.  
 d) A returning pulse is divided into three frequency bands if there is rotation. The size of the frequency difference between the bands increases as a planet's rotation rate increases. This is caused by the Doppler effect.  
 e) If there is rotation, a returning radio pulse makes a gobble-gobble sound.