

Tour of the Solar System

Spring 2009, Exam #1

February 12, 2009

1509

Instructions: There are a total of 20 problems in this exam, worth 5 points each. Attempt as many problems as possible, write your answers on the question sheet, and turn it in at the end of the class. You should need to write no more than a few sentences to answer descriptive questions. Please note that this is not an open-book exam: no books or notes may be used, and all electronic devices, including laptops, cellphones, calculators and iPods, must be switched off.

Be sure to fill out your name below.

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NAME: _____

~~XXXXXXXXXXXX~~

(please print legibly)

[1] Which of the 8 major planets in our Solar System have the following characteristics? Each has a unique answer.

M
V
E
R
J
S
U

- (a) The largest of all the planets *Jupiter*
- (b) The largest "terrestrial" planet *Mars*
- (c) The closest planet to the Sun *Mercury*
- (d) The 7th most distant planet from the Sun *Uranus*
- (e) The brightest planet in the sky as seen from Earth *Venus*

[2] Which of the four terrestrial planets has the densest atmosphere? Which of them lacks any significant atmosphere?

Venus has the densest atmosphere
Mercury has no significant atmosphere

[3] Pluto is now classified as a dwarf planet, not a major planet. State whether each of the following potential reasons for its change in status is true or false:

- ☒ (a) Pluto has a more eccentric orbit around the Sun than the major planets
- ☐ (b) Pluto does not have a moon and therefore cannot be considered a planet
- ☐ (c) Pluto lacks an atmosphere and therefore cannot be considered a planet
- ☐ (d) Pluto is irregular in shape, like an asteroid, not rounded, like a planet
- ☒ (e) Pluto is smaller than another body in orbit around the Sun beyond Neptune that is not considered a planet

Additional question for a bonus point:

True or false: the composer Gustav Holst refused to include Pluto in his Planets Suite because he was convinced that it was not a real planet.

True

[4] An observer on the Earth views a total eclipse of the Moon. What would an observer on the Moon who is simultaneously viewing the Earth see?

Select one:

- ☒ (a) A total eclipse of the Earth
- ☐ (b) A total eclipse of the Sun
- ☐ (c) A partial eclipse of the Earth
- ☒ (d) A partial eclipse of the Sun
- ☐ (e) An annular eclipse of the Sun

[5] Explain why total eclipses of the Moon for observers on Earth occur more frequently than total eclipses of the Sun.

A total eclipse of the sun requires the Moon to pass exactly in front of the sun, whereas a lunar eclipse only requires the earth's shadow, which is much larger than the moon, to cover the moon.

[6] State whether each of the following statements is true or false:

- T (a) When Venus is at greatest eastern elongation it may be observed in the evening sky after sunset
- F (b) When Mercury is at greatest eastern elongation it may be observed in the morning sky before sunrise
- T (c) When Mars is at opposition it displays a fully illuminated disk as viewed from the Earth
- T (d) There can never be an annular eclipse of the Moon
- T (e) A transit of Mercury occurs when Mercury passes directly between the Earth and the Sun

[7] Between 1902 and 1929, Daniel Barringer, a mining engineer from Philadelphia, invested large sums of money on a project to mine within the Meteor Crater in Arizona that is now named for him. He believed there to be rich and extensive mineral deposits from the original impactor buried below the surface, but none were ever found. Explain why his investment was not a good one.

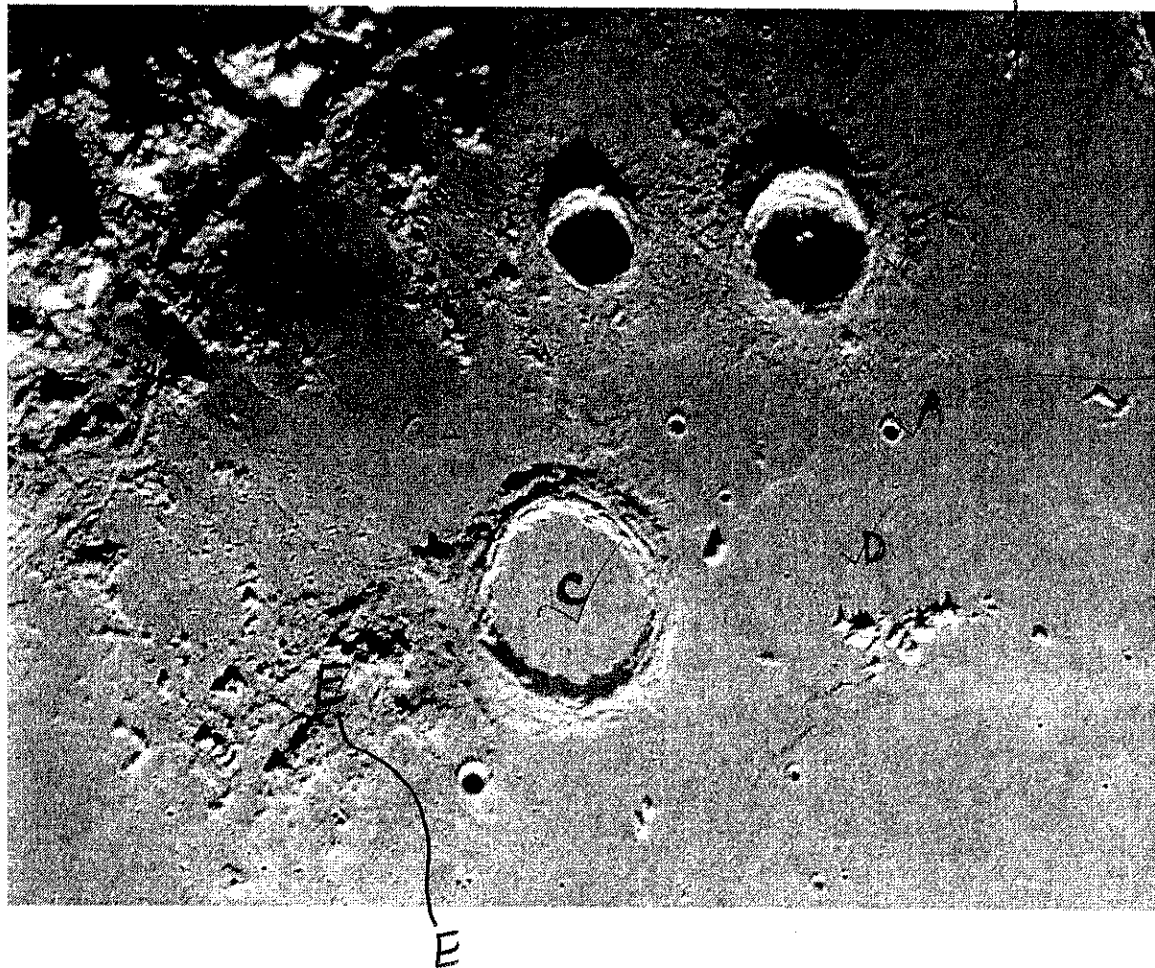
Because meteors have a high velocity at impact, the impact crater is significantly larger than the meteor which made it. The meteor which made the Barringer crater was not nearly as large as Barringer thought it was.

[8] Why does the Earth have far fewer impact craters compared with the Moon?
State two reasons.

- 1.) The earth has an atmosphere which protects it from many smaller meteors
- 2.) Earth's geologic activity (tectonic plate action, volcanism, erosion) all contribute to removing craters from earth's surface.

[9] Identify by labeling on the image of lunar cratered terrain below:

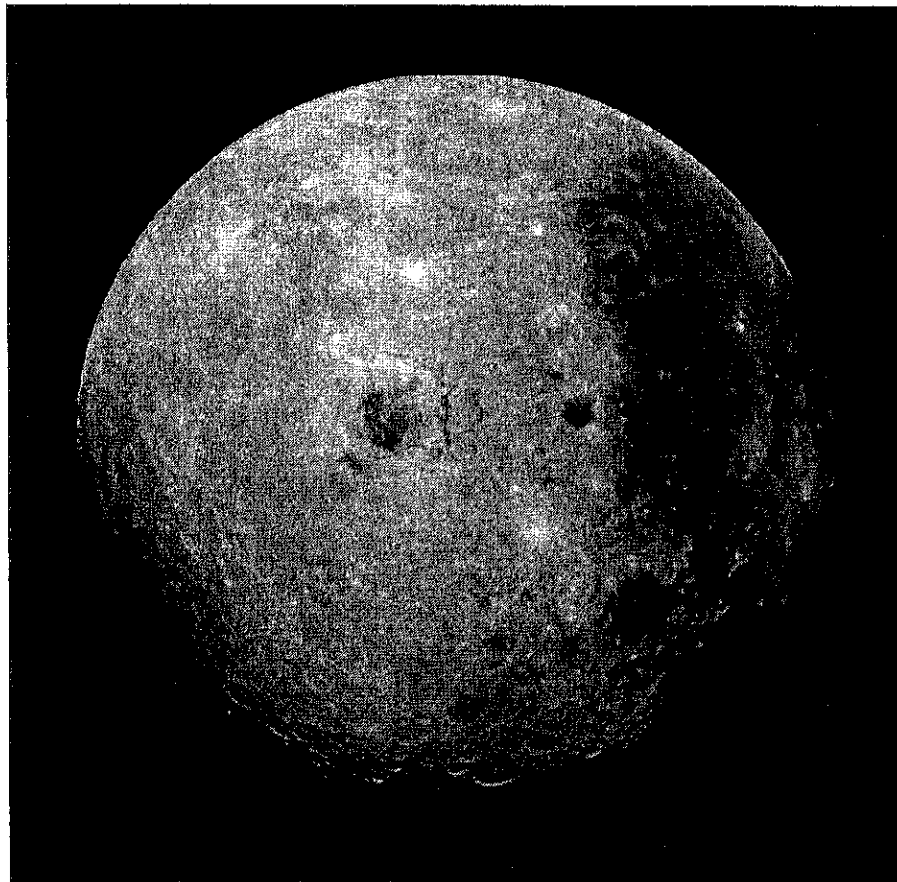
- (a) A simple impact crater
- (b) A complex impact crater
- (c) An impact crater that subsequently flooded with magma
- (d) A volcanic plain
- (e) Debris ejected by an impact that formed a crater



[10] The Moon's highlands have an average crater density per unit surface area that is a factor of about 10 higher compared with the lunar plains ("mare"). Which of the following is the most likely explanation of this fact? (There is only one correct answer).

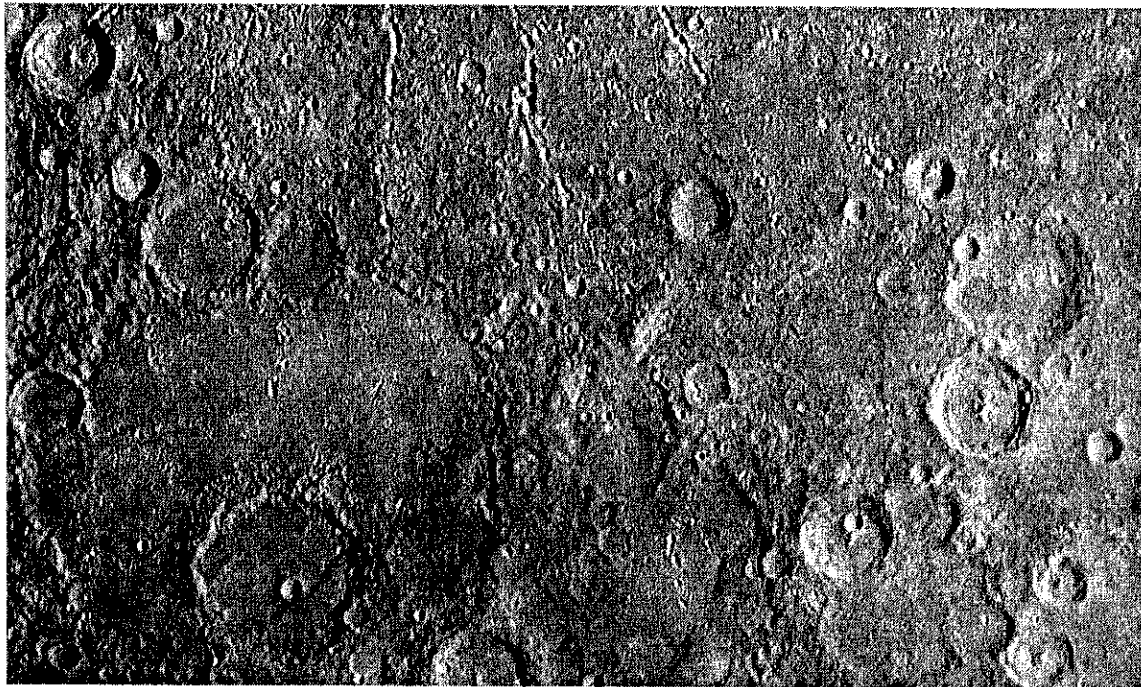
- (a) Because the plains are made of basalt, which is dense, they were impervious to impacts.
- ☒ (b) Volcanic activity destroyed most of the older craters on the plains.
- (c) Crater-forming impacts were more frequent on the highlands.

[11] The image of the Moon below, taken by the Galileo spacecraft, shows a different (side-on) view compared with what we see from Earth. The lunar north and south poles are toward the top and bottom of the disk, respectively. Indicate by labeling with an arrow below the most probable direction of the Earth relative to the Moon on this image.



[12] The image of cratered terrain on Mercury below was taken by the Messenger Mission during a recent flyby. By studying the distribution of craters and their sizes, determine which of the following statements is most likely to be true (there is only one correct answer):

- ☒ (a) The larger impacts mostly occurred early in Mercury's history; the more recent ones tend to be smaller.
- (b) The early impacts were generally small; the larger ones came later.
- (c) Small and large impacts occurred at about the same rate throughout the cratering process.



[13] It is generally agreed that Mercury must have a large core composed mostly of iron. Which of the following statements is the true reason for this conclusion? (There is only one correct answer).

- ☒ (i) Iron is the only abundant planetary material that is dense enough to explain Mercury's high average density.
- (ii) Seismic data from NASA missions to Mercury indicate the presence of an iron core.
- (iii) Images show that Mercury has an iron-rich crust and therefore must also have an iron-rich core.

[14] A shield volcano is observed at a particular location on the Earth's surface. Which of the following statements is most likely to be true? (There is only one correct answer).

- (a) The region is close to a lateral fault
- ☒ (b) The region might be close to a rift zone, or it might be remote from any tectonic plate boundary
- (c) The region is close to a subduction zone

[15] A strato (cone-shaped) volcano is observed at a particular location on the Earth's surface. Which of the following statements is most likely to be true? (There is only one correct answer).

- (a) The region is close to a rift zone
- ☒ (b) The region is close to a subduction zone
- (c) The region is remote from any tectonic plate boundary

[16] Rock samples collected by the Apollo astronauts from the dark (mare) regions of the Moon proved to be igneous basalt (i.e. of volcanic origin and rich in iron), yet volcanic mountains are not prevalent on the surface of the Moon. Is this surprising? Briefly explain how the mare are believed to have formed.

No. The mare formed when impact craters were so deep, that they flooded with magma.
(Like how a deep hole dug at the beach fills with water)

[17] Of the two major classes of volcano found on Earth (strato and shield), only one is found on Venus. Which one? What is the significance of this result?

Shield volcanos are the only type found on Venus. This suggests Venus does not have tectonic plate activity.

[18] Radar maps of the surface of Venus have demonstrated that the entire surface is uniformly cratered, with a density much less than the most highly cratered areas of the Moon. What can we deduce from this about the way Venus' crust has evolved?

The entire surface of Venus has been renewed around the same time, most likely as a result of planet-wide catastrophic volcanism.

[19] If present-day Venus could be towed away from the Sun, to a distance similar to the distance of the Earth from the Sun, do you think it would become a suitable habitat for life? Explain your answer. (Assume that Venus and the Earth do not collide!)

No. Even if the runaway greenhouse effect could be stopped + the planet cooled, Venus still lacks one main component required for life to exist; water.

2 [20] On the Moon, craters above about 20 km in diameter are usually complex and those below 20 km are usually simple. Would you expect this "cross-over size" between simple and complex craters to be greater, smaller, or about the same on a more massive planetary body such as Mercury? (Assume that its surface is made of the same material). Explain your answer.

The surface of the moon and mercury are pretty much impossible to tell apart. Also, no matter how massive the planet, meteor's terminal velocity does not change. Therefore, I would expect this "cross-over size" to be about the same.