

NOTE: answers in **RED**
have clarifications at the
bottom of the page!

Test #: _____ Time: _____

Solar System — 2018 — Answer key

Section 1 (1 pt per question unless marked otherwise)

Subscore: _____/23

- | | | | |
|-------------|------------------------------|-------------------------------|--------------|
| 1. <u>B</u> | 6. (2) CD | 11. <u>A</u> | 16. <u>C</u> |
| 2. <u>A</u> | 7. <u>C</u> | 12. <u>2</u> | 17. <u>D</u> |
| 3. <u>D</u> | 8. (1) A (1) D | 13. (1) B (1) E | 18. <u>A</u> |
| 4. <u>C</u> | 9. <u>D</u> | 14. <u>D</u> | 19. <u>B</u> |
| 5. <u>F</u> | 10. <u>4</u> | 15. <u>B</u> | 20. <u>D</u> |

Section 2 (1 pt per question unless marked otherwise)

Subscore: _____/32

- | | | | |
|--------------|--------------------------|-----------------|-------------------------------|
| 21. <u>B</u> | 29. (3) 400 times | 31. <u>1345</u> | 39. <u>B</u> |
| 22. <u>F</u> | 30. (3) 380 times | 32. <u>3485</u> | 40. <u>C</u> |
| 23. <u>G</u> | | 33. <u>94</u> | 41. <u>A</u> |
| 24. <u>H</u> | | 34. <u>49</u> | 42. <u>F</u> |
| 25. <u>D</u> | | 35. <u>6</u> | 43. <u>E</u> |
| 26. <u>C</u> | | 36. <u>0</u> | 44. <u>D</u> |
| 27. <u>A</u> | | 37. <u>0</u> | 45. (1) K (1) G |
| 28. <u>E</u> | | 38. <u>21</u> | 46. (1) I (1) G |

Section 3 (1 pt per question unless marked otherwise)

Subscore: _____/15

- | | | | |
|--------------|--------------|----------------------|--------------|
| 47. <u>D</u> | 51. <u>C</u> | 55. <u>A</u> | 59. <u>A</u> |
| 48. <u>A</u> | 52. <u>B</u> | 56. (2) Tycho | 60. <u>C</u> |
| 49. <u>B</u> | 53. <u>A</u> | 57. <u>B</u> | |
| 50. <u>D</u> | 54. <u>B</u> | 58. <u>A</u> | |

Scoring Notes

- 6. No partial credit. Order doesn't matter.
- 8, 13. One point per letter. Order doesn't matter.
- 29, 30. Answer must be exactly as written (see test for why).
- 45, 46. One point per letter. Order doesn't matter.
- 56. Also accept "Brahe", or "Tycho Brahe". Spelling doesn't need to be perfect.

Tiebreakers: Section 2 subscore, section 1 subscore, time

Team name: _____

Your name(s): _____

Test #: _____ Time: _____

Solar System — 2018 — Answer sheet

Section 1 (1 pt per question unless marked otherwise)

Subscore: _____/23

- | | | | |
|----------|--------------------------------------|---------------------------------------|-----------|
| 1. _____ | 6. (2) _____ | 11. _____ | 16. _____ |
| 2. _____ | 7. _____ | 12. _____ | 17. _____ |
| 3. _____ | 8. (1) _____ (1) _____ | 13. (1) _____ (1) _____ | 18. _____ |
| 4. _____ | 9. _____ | 14. _____ | 19. _____ |
| 5. _____ | 10. _____ | 15. _____ | 20. _____ |

Section 2 (1 pt per question unless marked otherwise)

Subscore: _____/32

- | | | | |
|-----------|----------------------------|-----------|---------------------------------------|
| 21. _____ | | 31. _____ | 39. _____ |
| 22. _____ | 29. (3) _____ times | 32. _____ | 40. _____ |
| 23. _____ | | 33. _____ | 41. _____ |
| 24. _____ | 30. (3) _____ times | 34. _____ | 42. _____ |
| 25. _____ | | 35. _____ | 43. _____ |
| 26. _____ | | 36. _____ | 44. _____ |
| 27. _____ | | 37. _____ | 45. (1) _____ (1) _____ |
| 28. _____ | | 38. _____ | 46. (1) _____ (1) _____ |

Section 3 (1 pt per question unless marked otherwise)

Subscore: _____/15

- | | | | |
|-----------|-----------|----------------------|-----------|
| 47. _____ | 51. _____ | 55. _____ | 59. _____ |
| 48. _____ | 52. _____ | 56. (2) _____ | 60. _____ |
| 49. _____ | 53. _____ | 57. _____ | |
| 50. _____ | 54. _____ | 58. _____ | |

Tiebreakers: Section 2 subscore, section 1 subscore, time

Solar System — 2018

This page intentionally left blank.

(You'll thank me when you get to section 3)

Section 1: Images

Note: unless otherwise specified, all questions are worth one (1) point.

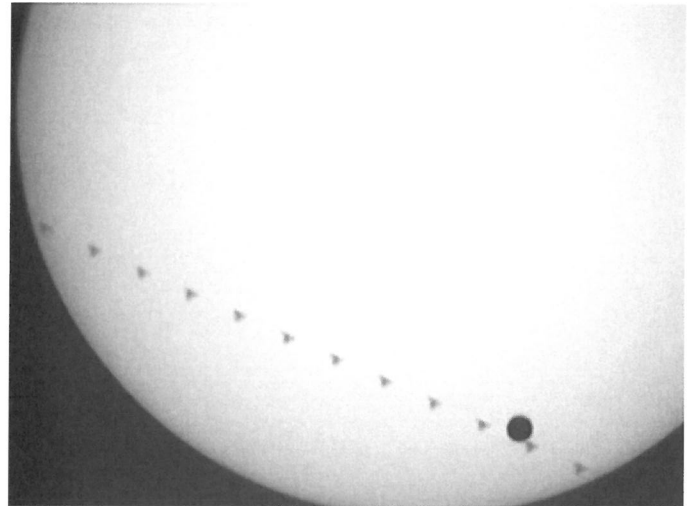
The image below is actually a sequence of photos of the Sun, taken on June 8, 2004. The set of small blotches in a straight line shows the path of the International Space Station across the disk of the Sun.

1. What is the large dark spot near the bottom of the Sun?

- A. The Moon
- B. Venus
- C. Mercury
- D. Mars

2. Which is larger: the Sun or the object causing the dark spot?

- A. The Sun
- B. The object
- C. Both are the same size
- D. We need more information; the photo alone is not enough



3. Which of the following is most like the event shown in the image?

- A. New moon
- B. Total lunar eclipse
- C. Partial solar eclipse
- D. Annular solar eclipse

4. Why is this image black and white?

- A. Clouds blocked most of the color of the Sun that day
- B. Viewed from space, the Sun is actually closer to white than yellow
- C. The photographer only released a black-and-white image of the event
- D. Color photography had not yet been invented

5. Earlier instances of this event (in the 17th and 18th centuries) were used to calculate which of the following?

- A. The distance to the Sun
- B. The size of the Sun
- C. The solar parallax
- D. A and B
- E. B and C
- F. A, B, and C

The image below is an artist's illustration of a recent NASA mission. The blue tail coming off the spacecraft is a special "ion thruster", which was used to visit targets in the asteroid belt.

6. (2 pts) The asteroid belt lies between which two planets? **There are two correct answers. You must give both for credit.**

- A. Venus
- B. Earth
- C. Mars
- D. Jupiter
- E. Saturn
- F. Uranus

7. Which mission is the subject of this image?

- A. Mariner 9
- B. Pioneer
- C. Dawn
- D. Galileo

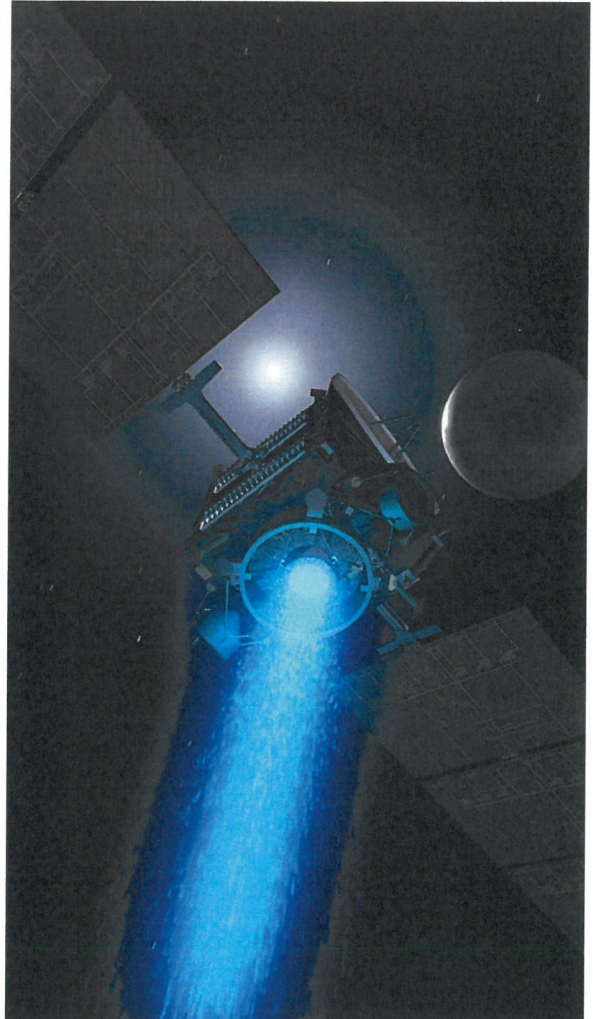
8. (2 pts) Which of the following did this mission visit? **There are two correct answers. You will receive one point for each.**

- A. Ceres
- B. Jupiter
- C. The Moon
- D. Vesta
- E. Phobos
- F. Venus

9. Ceres in the above list is considered a "dwarf planet", not a true planet, because...

- A. it does not orbit the Sun directly.
- B. it has no natural moons.
- C. its gravity is not strong enough to cause a sphere-like shape.
- D. it has not cleared its orbital neighborhood of other material.

10. How many of the answer choices in question 8 orbit the Sun directly?



The picture below shows the north pole of an object named on the official rule sheet.

11. Which object is this a photo of?

- A. Mars
- B. Mercury
- C. Io
- D. Ceres

12. How many moons does this object have?

13. (2 pts) The ice cap shown is made of which of the following chemicals? **There are two correct answers. You will receive one point for each.**

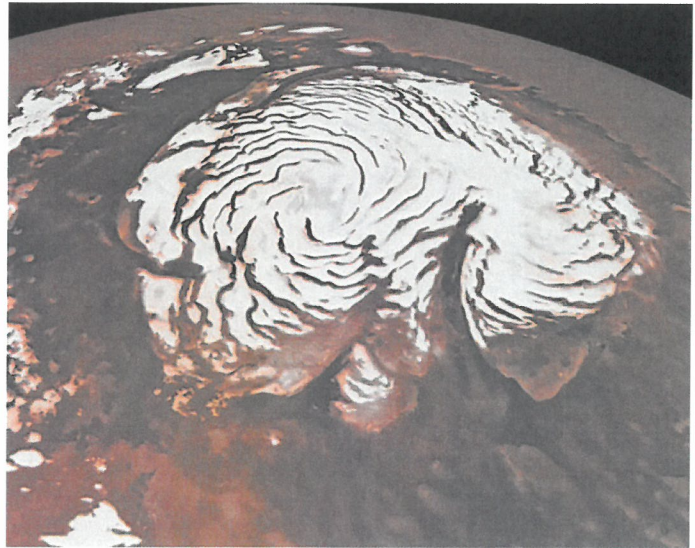
- A. Oxygen
- B. Carbon dioxide
- C. Ammonia
- D. Iron oxide
- E. Water
- F. Sulfuric acid

14. Which of the following kinds of missions have been sent to this object?

- A. Orbiting satellites
- B. Unmanned rovers
- C. Manned landers
- D. A and B
- E. A and C
- F. A, B, and C

15. Why are scientists excited that there is water on this object?

- A. Because rain will wash the dust off their equipment
- B. Because that means life might exist (or used to exist) there
- C. Because beachfront property on Earth is too expensive
- D. Because it is different from the water on Earth



The image below is of a moon within the Solar System.

16. What is the name of this moon?

- A. *The Moon*
- B. Phobos
- C. Io
- D. Calypso

17. Which planet does this moon orbit?

- A. Venus
- B. Earth
- C. Mars
- D. Jupiter

18. This moon is famous for what surface feature?

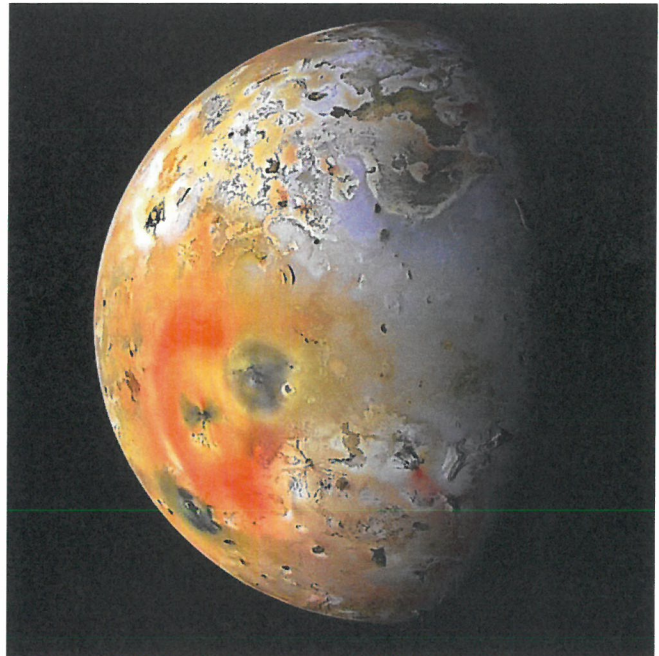
- A. Volcanoes
- B. Tidal waves
- C. Ice caps
- D. Canyons

19. This moon has almost none of which of the following features common on other moons in the Solar System?

- A. Clouds
- B. Water ice
- C. Craters
- D. Methane oceans

20. The interior of the planet is kept hot by which of the following?

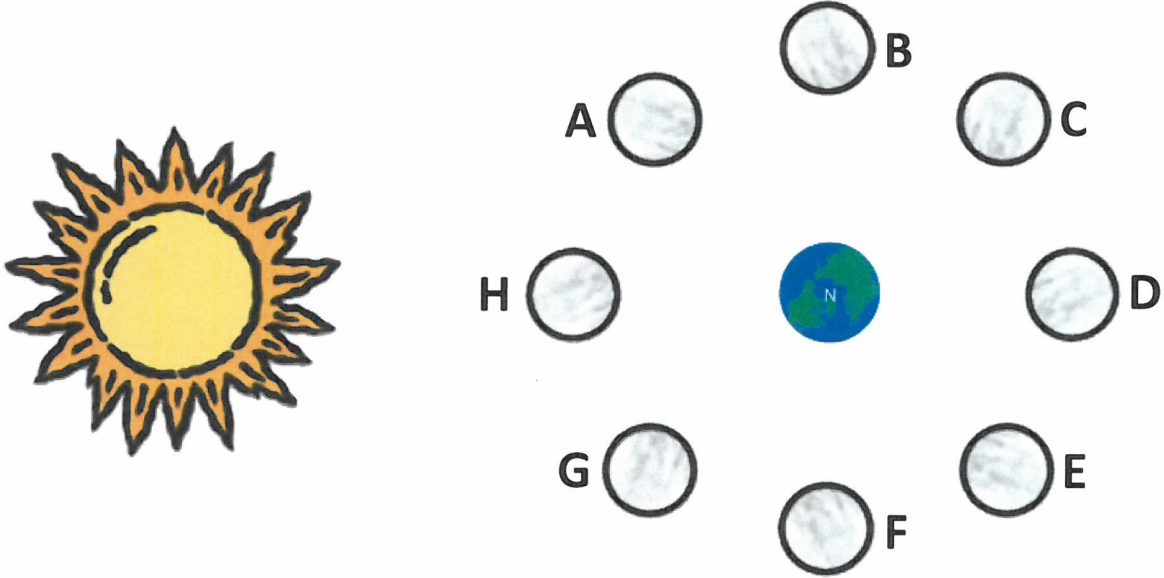
- A. Sunlight
- B. Radioactive decay
- C. Meteor impacts
- D. Tidal heating



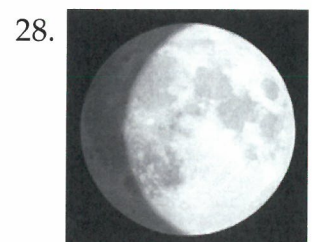
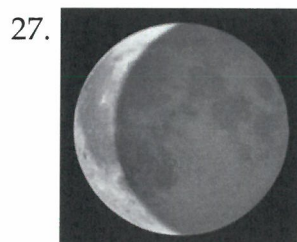
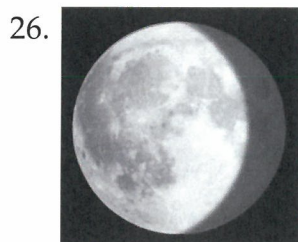
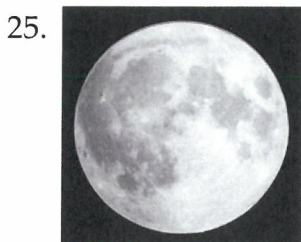
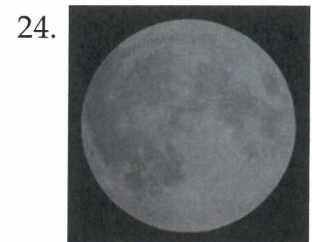
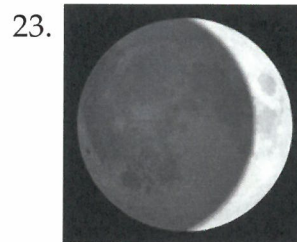
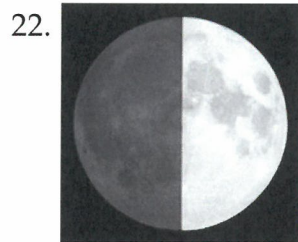
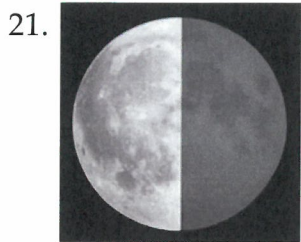
Section 2: Eclipses and Phases

Note: unless otherwise specified, all questions are worth one (1) point.

Questions 21-28 use the following diagram. It shows the Moon in several positions around the Earth. It is viewed from above the north pole. Note that distances and sizes are *not* to scale!



Each question below shows the Moon as it might appear to someone in North Carolina looking south (that is, the Moon's north pole is up on these pictures and east is to the left). **Match the image of the Moon (below) to its position relative to Earth and the Sun (above).**

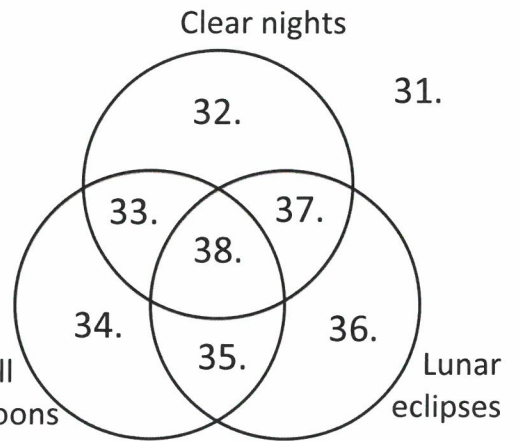


29. (3 pts) The Moon is 3.6 times smaller than Earth. The Sun is 110 times larger than Earth. How many times larger than the Moon is the Sun? Round your answer to the nearest ten.

30. (3 pts) The Moon is 400,000 km from Earth. The Sun is 150,000,000 km from Earth. How many times farther is the Sun than the Moon? Round your answer to the nearest ten.

Questions 31-38 involve the Venn diagram at right.

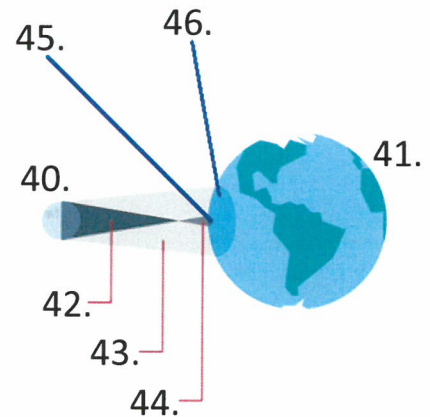
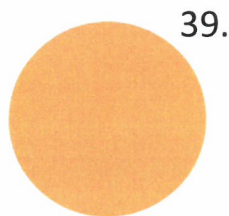
Over 5,000 nights at a location, 3,600 of them were clear. During this time, there were 170 full moons. 115 of those full moons occurred on clear nights. There were also 27 lunar eclipses, of which 21 happened on clear nights.



Use this information to fill out all eight spaces of the Venn diagram. (Pay attention to the location of question 31!)

Questions 39-46 use the word bank below. Some choices may be used more than once, and some may not be used at all. For all questions, **write the letter and not the word on your answer sheet.**

- | | |
|-------------|------------|
| A. Earth | G. Solar |
| B. Sun | H. Lunar |
| C. Moon | I. Partial |
| D. Antumbra | J. Total |
| E. Penumbra | K. Annular |
| F. Umbra | L. Hybrid |



39-44. Identify the objects marked on the diagram.

45. (2 pts, 1 each) People at this location would see a/an _____ _____ eclipse.

46. (2 pts, 1 each) People at this location would see a/an _____ _____ eclipse.

Section 3: The Moon!

Note: unless otherwise specified, all questions are worth one (1) point.

47. What do scientists call the material that makes up the outermost surface of the Moon?
- A. Mantle
 - B. Dirt
 - C. A real pain to clean off spacesuits
 - D. Regolith
48. On Earth, water erosion and biological processes are responsible for the terrestrial version of the answer to question 47. What process creates/created the material on the Moon?
- A. Meteor impacts
 - B. Acid rain
 - C. Biological activity
 - D. Radioactive decay

Below is a photo of the Moon. (Yeah, no way am I asking you to identify *that* for points.) Several features have been marked by lines leading to numbers.

49. What is the name for the dark features on the surface of the Moon, one of which has been marked with the number "1"?

- A. Highlands
- B. Mare
- C. Grabens
- D. Cratons

50. What kind of feature has been marked with the number "2"?

- A. Lunar ridge
- B. Basin
- C. Regolith
- D. Crater

51. Features mentioned in question 50 often have a system of lines spreading out from them. One example is marked with the number "3". What are these lines called?

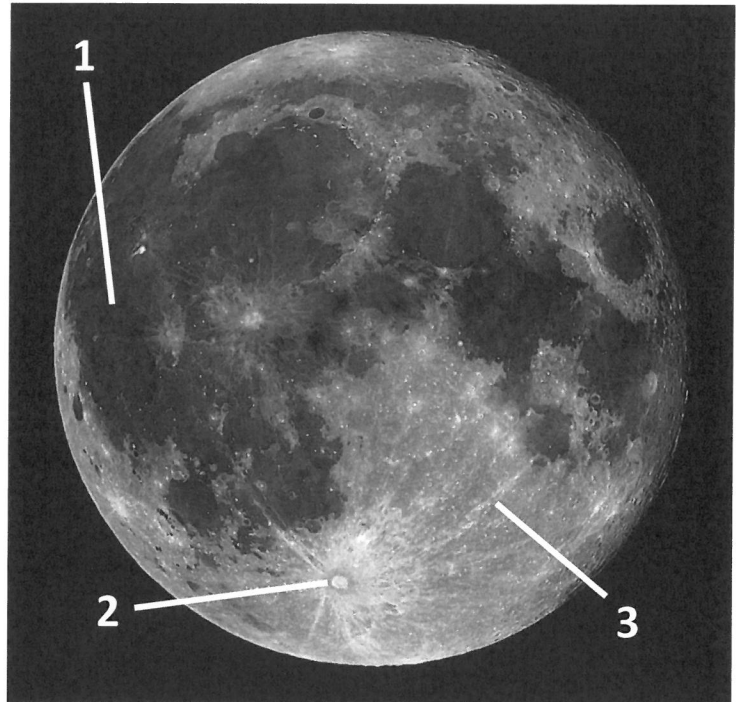
- A. Wrinkle ridges
- B. Lava channels
- C. Rays
- D. Secondary craters

52. What is the origin of the features mentioned in question 49 (marked by a "1" on the photo)?

- A. Meteor impacts
- B. Volcanic floods
- C. Cometary accumulation
- D. Solar irradiation

53. Over time, the features marked by "3" will change color and fade into their surroundings. What is this process called?

- A. Space weathering
- B. Selenic whitening
- C. Albedo shift
- D. Lunar bleaching



54. Which has a higher elevation relative to the average height of the lunar surface, the darker side marked by a "1" or the lighter side surrounding features "2" and "3"?
- A. The dark side is at higher elevation
 - B. The light side is at higher elevation
 - C. Both are at the same elevation, and the color difference is coincidental
 - D. The answer varies over the course of each month
 - E. You were expecting a Star Wars reference in this question, weren't you?
55. Moon rocks collected in feature "1" are rich in what substance, consistent with the origin you identified in question 52?
- A. Iron
 - B. Water
 - C. Graphite
 - D. Sodium
56. (2 pts) The feature marked with a "2" is named after which scientist?
57. Which of the following is the current scientific explanation for the origin of the Moon?
- A. It formed at the same time Earth did, in orbit around Earth.
 - B. It formed after a giant meteor struck Earth and ejected lots of rock.
 - C. It migrated inward from the asteroid belt, eventually being captured by Earth.
 - D. Enormous dairy factories in space
58. The Moon is massive enough that it underwent differentiation after it formed. What does that mean?
- A. It separated into layers as denser material sank toward its center.
 - B. Material near the surface changed color compared to material deeper down.
 - C. Plate tectonics caused the lunar surface to divide into oceans and highlands.
 - D. Radioactivity caused large clusters of volcanic eruptions.
59. The same side of the Moon always points toward Earth. What is that called?
- A. Tidal locking
 - B. Milankovitch blocking
 - C. Antipodal fixing
 - D. Orbital resonance
60. Which of the following missions visited the Moon?
- A. New Horizons
 - B. Fermi
 - C. Apollo
 - D. Pioneer

No math section at the regional test, but those of you who make it to State had better study up!