



“My battery is low and it’s getting dark” – Oppy 2004-2019

SOLAR SYSTEM
NEW MEXICO SCIENCE OLYMPIAD
STATE TOURNAMENT 2019

COMPETITORS: _____

TEAM NAME: _____

Part I: Matching (20 pts)

Using the options below, select the choice that fits most closely to the description provided.

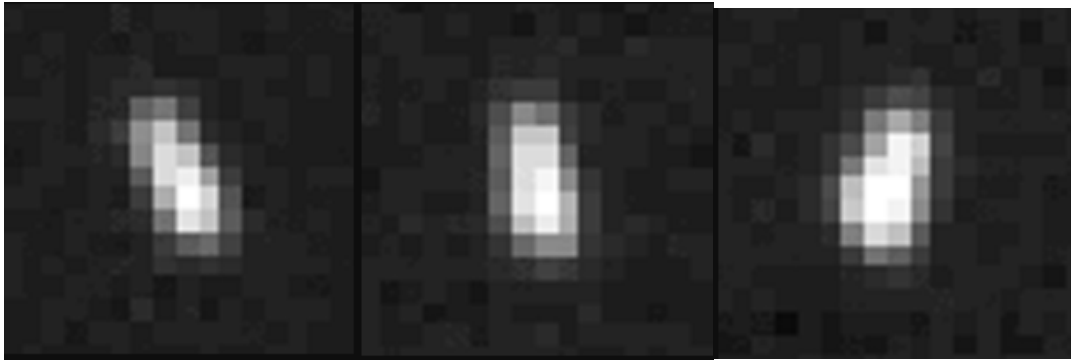
A. Albedo	B. Asteroid Belt	C. Ceres
D. Charon	E. Eris	F. Dawn
G. Haumea	H. Jovian Trojans	I. Juno
J. Kuiper Belt	K. Lucy	L. Makemake
M. Mimas	N. Mercury	O. Centaurs
P. Oumuamua	Q. Phoebe	R. Pluto
S. Tidal Locking	T. Trojans	U. Lagrangian Points

1. _____ (1 pt) The region of our solar system beyond Neptune
2. _____ (1 pt) Planetisimals that cross the orbits of one or more gas giants on their orbit around the sun
3. _____ (1 pt) Celestial bodies that orbit approximately 60° ahead of or behind a planet that follows the same orbit as that planet
4. _____ (1 pt) Point or points near two large celestial bodies that, when occupied by a smaller celestial body, is the region where the smaller celestial body will maintain its relative position near or between the larger orbiting bodies
5. _____ (1 pt) The mathematical measure of an object's ability to reflect light
6. _____ (1 pt) The most massive dwarf planet known in the solar system

7. _____ (1 pt) A satellite body that is nearly $\frac{1}{2}$ the diameter of the body it orbits
8. _____ (1 pt) The first interstellar body ever catalogued
9. _____ (1 pt) The family of objects located between Mars and Jupiter, housing several dwarf planets
10. _____ (1 pt) The physical condition in which one face of a satellite body is perpetually facing the celestial body which it orbits
11. _____ (1 pt) The family of asteroids that share the orbit of Jupiter
12. _____ (1 pt) Discovered by Clyde Tombaugh, this dwarf planet possesses a moon that was discovered by the New Horizon's mission in July of 2015
13. _____ (1 pt) Moon of Saturn that is hypothesized to have been captured by the giant's intense gravity long after the planet's formation
14. _____ (1 pt) The planet possessing the most elliptical orbit in the solar system
15. _____ (1 pt) A potato-shaped dwarf planet
16. _____ (1 pt) The largest known object in the Kuiper belt
17. _____ (1 pt) A moon with a crater in its surface that is $\frac{1}{4}$ the diameter of the moon
18. _____ (1 pt) A celestial body named after the Greek Goddess of strife and discord
19. _____ (1 pt) The mission to visit the largest asteroid in the asteroid belt
20. _____ (1 pt) A mission to the objects that share their orbit with Jupiter

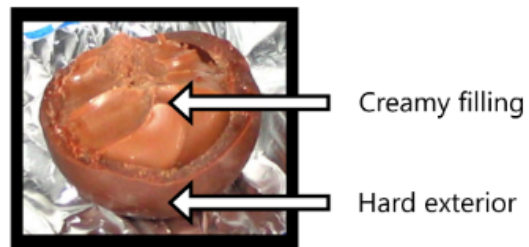
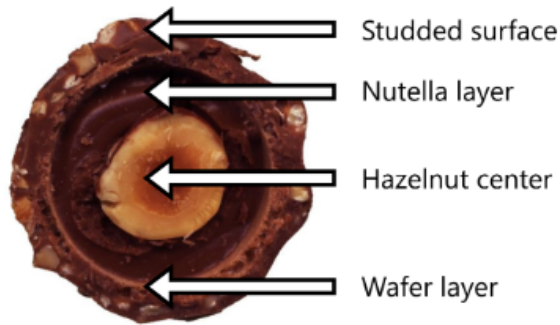
Part II: Short Answer (25 pts)

21. (6 pts) Given the images below, write a few sentences describing what objects and/or phenomena are depicted, and what mission satellite likely produced the images. Be sure to include a description of the type of data that was used in the production of these images and the type of sensor used to collect that data. You may also draw diagrams of the complete process represented in these images.

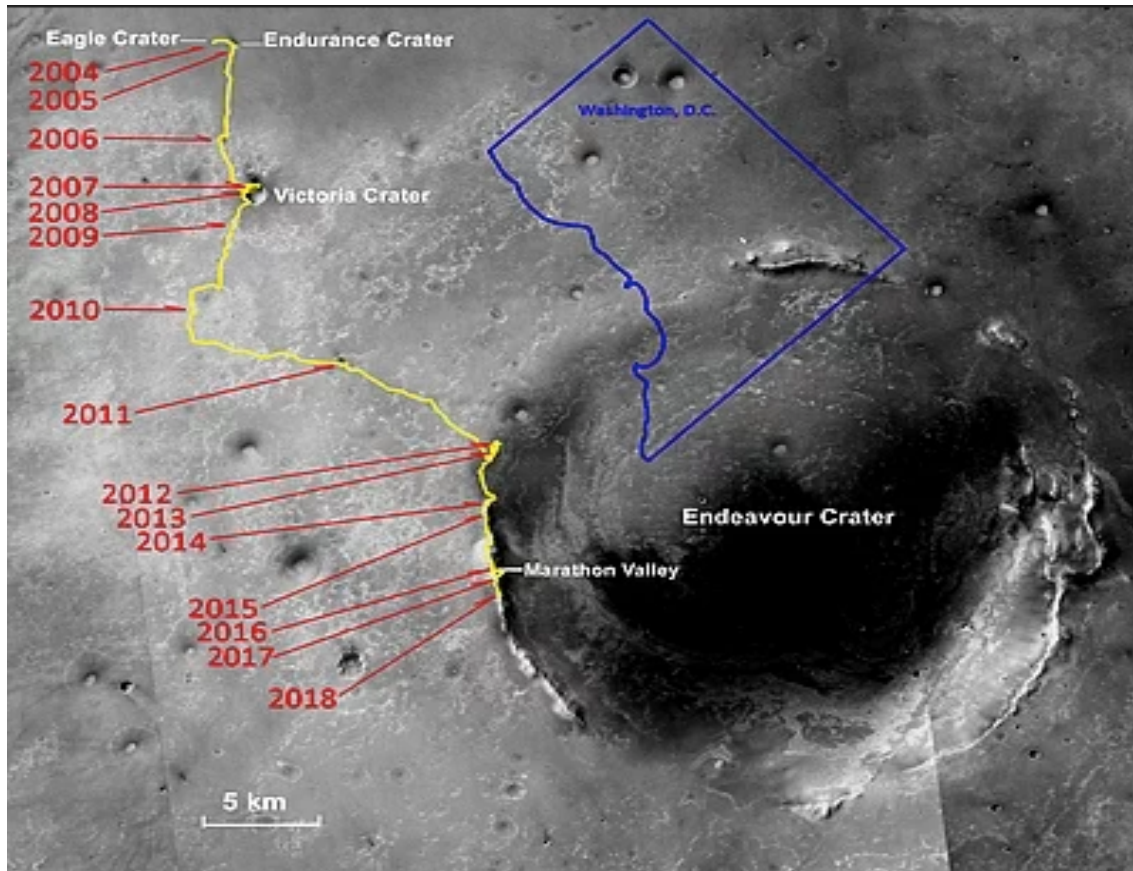


22. (6 pts) Describe the process by which our solar system formed. Be sure to include words like “first, second” and “then, next” in your explanation to show the order in which these events happened. You may also draw a diagram, but make sure to label each step in the process.

23. (6 pts) Ferrero Rocher and Lindor Truffles are two types of spherical chocolates. Below is an image of a cross section of each chocolate for reference. The main structure of the Ferrero Rocher is a spherical wafer which is filled with Nutella and a whole hazelnut in the center. The wafer is surrounded by a layer of chocolate studded with crushed hazelnuts. On the other hand, Lindor truffles have two components: a hard, smooth chocolate exterior, and a creamy, liquid chocolate interior. The diagrams for both are shown below. Under each picture, compare contrast the internal and external structure of that chocolate with the structure of the earth. You can make a bullet list of the similarities and differences for brevity.



24. (6pts) Given the image below, describe what event or events are shown.



25. (6 pts) Describe, in your own words, what purpose of the upcoming Lucy mission (set to launch in 2021) has, where it is going, and what it will do when it gets there. You may also provide diagrams of orbital paths, the bodies Lucy plans to study, and anything else relevant to this question.

Part III: Multiple Choice (20 pts)

26. _____ (1 pt) The Dwarf planet Pluto was discovered by
- a. Isaac Newton
 - b. Subrahmanyan Chandrasekhar
 - c. William Herschel
 - d. Clyde Tombaugh
27. _____ (1 pt) True or False: Voyager 1 was launched AFTER Voyager 2
- a. True
 - b. False
28. _____ (1 pt) True or False: Lucy is the first mission to visit more than 3 objects
- a. True
 - b. False
29. _____ (1 pt) The Cassini space craft is named after
- a. The astronomer who first estimated the dimensions of the solar system
 - b. The astronomer who was also a monk
 - c. The astronomer who was followed by three generations of his children as directors of the Paris observatory
 - d. all of the above
30. _____ (1 pt) True or False: 'Oumuamua is the first interstellar asteroid to visit the solar system.
- a. True
 - b. False
31. _____ (1 pt) The Kuiper Belt is
- I. Where planets that are too small go to die
 - II. A region of the solar system extending from 20-50 AU

III. 20–200 times as massive as the main asteroid belt

IV. Includes the Oort Cloud

- a. I only
- b. II only
- c. III only
- d. IV only
- e. I and II only
- f. II and III only
- g. III and IV only
- h. I and III only
- i. I and IV only
- j. II and IV only
- k. All are correct

32. _____ (1 pt) The length of ‘Oumuamua is

- a. 12 km
- b. 1 au
- c. 3°
- d. 700’

33. _____ (1 pt) ‘Oumuamua was discovered in

- a. 1999
- b. 2017
- c. 2019
- d. 1876

34. _____ (1 pt) a TNO is

- a. an object that is farther from the sun than Neptune

- b. a volcanic object on the surface of rocky planets**
- c. a Trojan**
- d. one of the objects that Lucy will visit after its launch in 2021**

35. _____ (1 pt) Haumea is named after

- a. the Hawaiian word for potato**
- b. the Hawaiian goddess of childbirth and fertility**
- c. the Hawaiian word for ice cube**
- d. a pre-colonial Hawaiian princess**

36. _____ (1 pt) The earth's moon was formed by

- a. dust that spins really really fast**
- b. being a rogue planet that enters a new solar system to orbit another planet**
- c. planetisimals congealing together**
- d. two planetisimals colliding and shearing off part of one of the bodies, the**

debris of which orbits one of the remaining planetisimals.

37. _____ (1 pt) Makemake is a

- a. dwarf planet**
- b. an asteroid orbited by one other asteroid**
- c. the largest object in the Kuiper belt besides Pluto**
- d. all of the above**

38. _____ (1 pt) (225088) 2007 OR10 is

- a. planet x**
- b. the largest unnamed object in the Solar System**
- c. was discovered by William Herschel**

39. _____ (1 pt) The perceived wagging of the moon's surface by earth-bound observers is

- a. an eclipse
- b. tidal locking
- c. libration
- d. periodic

40. _____ (1 pt) True or False: The penumbra is the darkest part of the shadow casted by the earth or the moon in a partial eclipse

- a. True
- b. False

41. _____ (1 pt) The unconsolidated, heterogeneous superficial sedimentary deposits covering bedrock is called

- a. clay
- b. dust
- c. regolith
- d. soil

42. _____ (1 pt) Counting craters is a method of

- a. wasting time
- b. measuring atmospheric composition
- c. weathering
- d. surface dating

43. _____ (1 pt) The order of the phases of the moon go **B**.

- a. full moon, $\frac{3}{4}$ moon, $\frac{1}{2}$ moon, new moon, blue moon, $\frac{1}{4}$ moon
- b. First quarter, waxing crescent, new moon, waning crescent, last quarter, waning gibbous, full moon, waxing gibbous
- c. New moon, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, full

44. _____ (1 pt) Out of the following planets, which ones display volcanism?

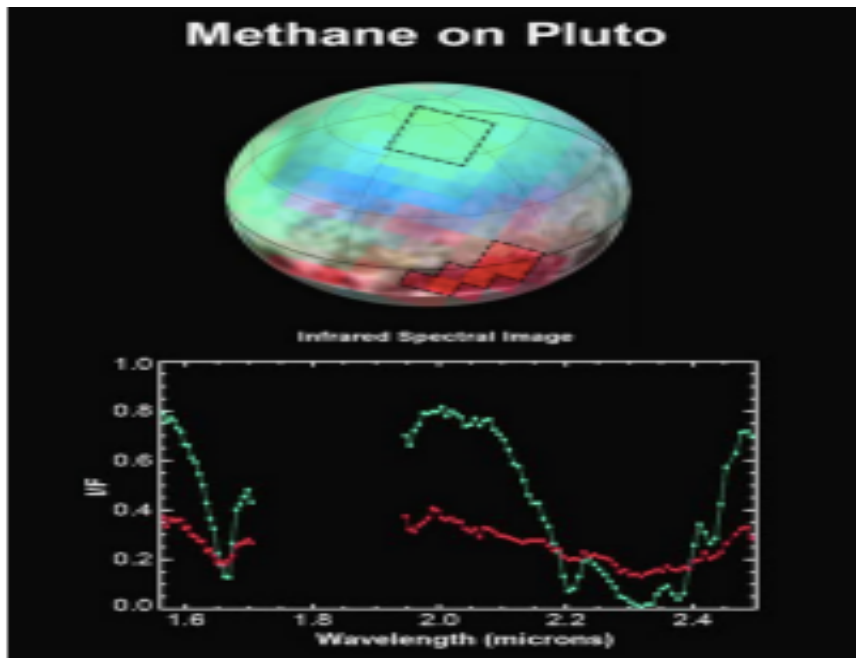
- a. Earth only**
- b. Venus and Earth**
- c. Earth and Mars**
- d. Earth, Venus, and Mars**

45. _____ (1 pt) a lunar eclipse is

- a. When the earth passes into the shadow of the moon**
- b. When the moon crosses between the sun and the earth**
- c. When the earth passes between the sun and the moon**
- d. Don't happen**

Part IV: Free Response (50 pts)

46. (10 pts) Using the image below, interpret the data shown and write a few sentences about what it means, what type of sensor collected the data, and if applicable, what object is shown.



47. (10 pts) In your own words, describe the methods used to determine atmospheric composition of faraway worlds. You may draw diagrams depicting these processes, as long as you label each part and provide a description to go along with it.

48. (10 pts) Using the image below, identify and describe in your own words the subject of the photo, what types of geologic features it displays, what object it is present on, and if applicable, what satellite and sensor produced the image.



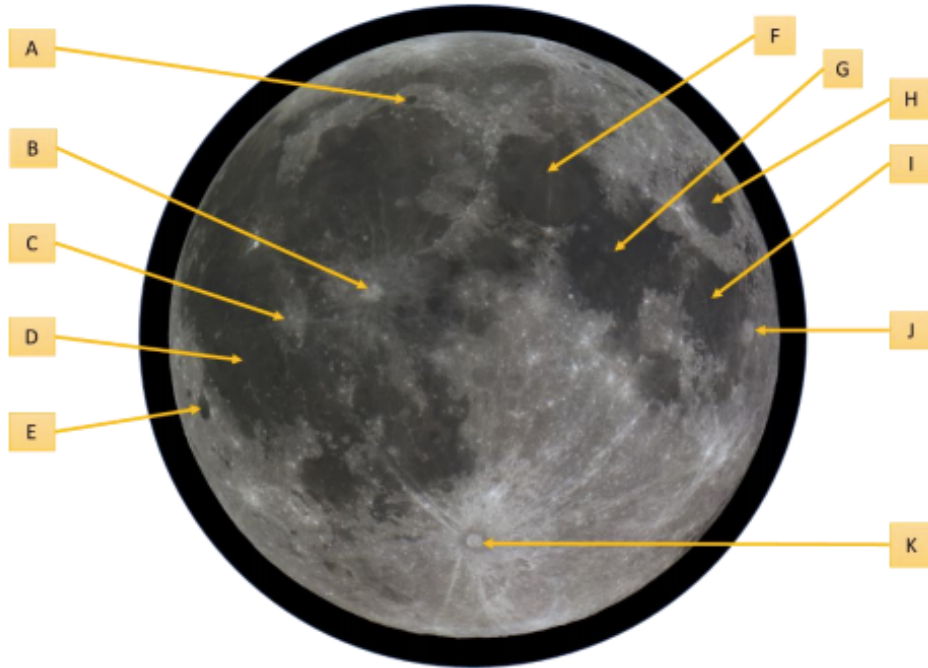
49. (10 pts) Explain in as much detail as you can the 'Giant Impact hypothesis' for how the Moon formed.

50. (10 pts) Describe in as much detail as you can the cause of the composition of rocky planets as we know it and how it effects the properties of those planets' atmospheres and ability to harbor life.

TIE BREAKERS

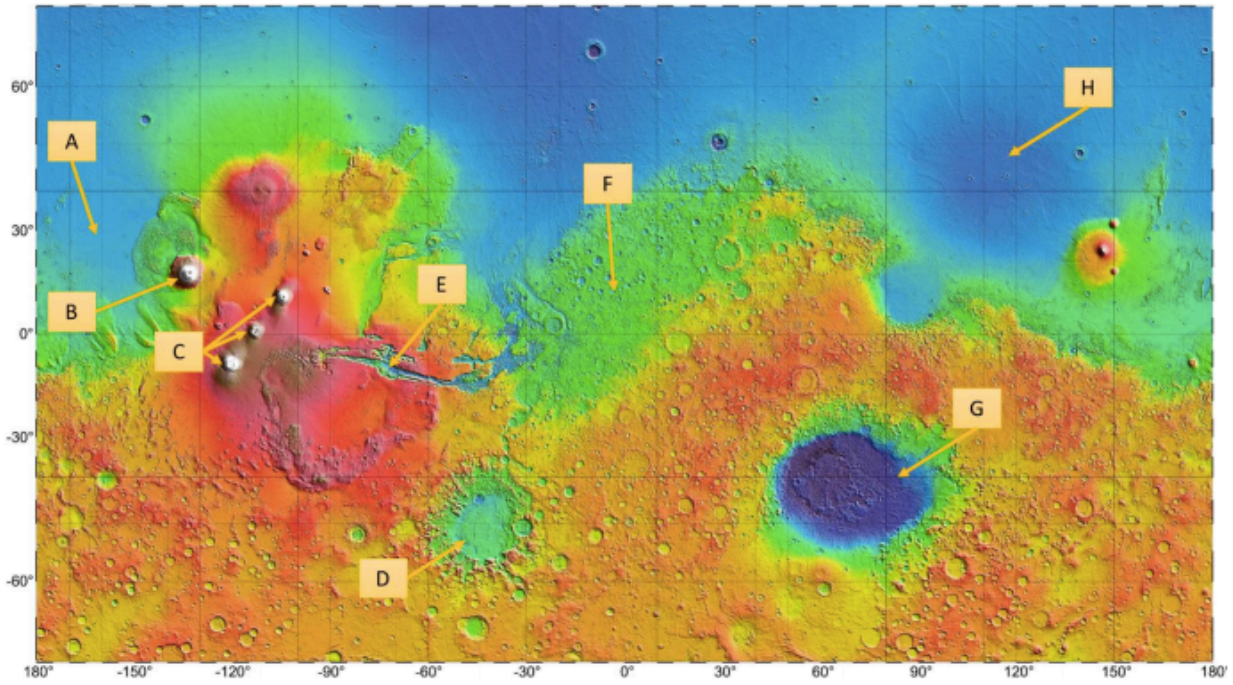
Your answers in this section will help to determine, in the event of a tie, each team's placement. Try to answer as many as you can fully and correctly in order to receive full credit. You WILL NOT be penalized for incorrect answers. Tie breakers are only counted in the event of a tie.

TB 1) Use the diagram below to answer parts A-K



- A. _____
- B. _____
- C. _____
- D. _____
- E. _____
- F. _____
- G. _____
- H. _____
- I. _____
- J. _____
- K. _____

TB 2) Use the diagram below to answer parts A-H



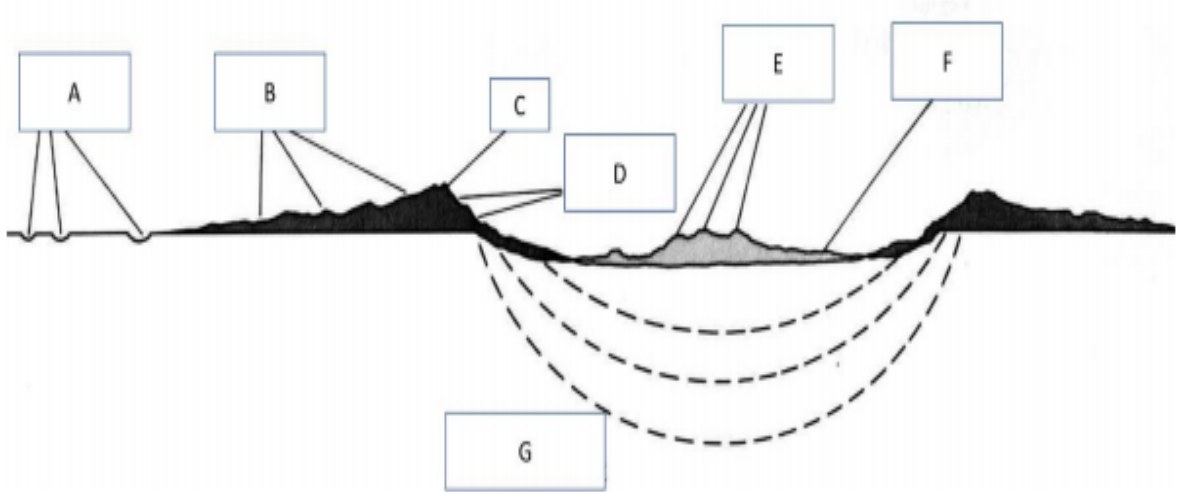
- A. _____
- B. _____
- C. _____
- D. _____
- E. _____
- F. _____
- G. _____
- H. _____

TB 3) _____ What are the techniques used to determine the age and geological history of the planets? Select the most correct answer.

- i. Law of superposition of geological features**
- ii. Stratigraphy**
- iii. Crater number density**
- iv. Radiometric dating**
- v. All of the above**

TB 4) The uplifting of which plateau created the largest canyons in our solar system, Valles Marineris? What caused this uplifting? You may draw diagrams to go along with your description of these aforementioned phenomena. Be sure to label them and provide a brief description of what they depict.

TB 5) Use the diagram below to answer parts A-G.



A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____