National Science Olympiad

Solar System 2019 (Division B)

January 2019

DO NOT GIVE THIS TO TEAMS. THIS IS THE ANSWER KEY

1. (10 points) What distinguishes a dwarf planet from other planets in the solar system?
   - ◯ Spherical in shape
   - ◯ Size ✓
   - ◯ In orbit around a star, but is not itself a satellite
   - ◯ All of the above
2. (10 points) List three other dwarf planets that are about the same small size as Pluto? Ceres , Makemake , and Eris
3. (10 points) Identify Pluto from the image set? Figure 3
4. (10 points) Which mission took the most recent optical image?
   - ◯ LUCY
   - ◯ DAWN
   - ◯ New Horizon ✓
   - ◯ CASSINI
5. (10 points) What is the only dwarf planet located in the inner solar system? [**Tiebreaker**] Ceres
6. (10 points) Which mission took the most recent optical image?
   - ◯ LUCY
   - ◯ DAWN ✓
   - ◯ New Horizon
   - ◯ CASSINI
7. (10 points) Identify this dwarf planet from the image set? Figure 1
8. (10 points) The Diagram showing a possible internal structure of a dwarf planet is shown in Figure 4, identify distinct internal layers? Rocky inner core, water-ice layer and thin dusty outer crust
9. (10 points) Identify dwarf planet Makemake from the image set?Figure 15
10. (10 points) Identify this dwarf planet Eris from the image set?Figure 2
11. (10 points) What is the name of the moon belonging to Eris? Dysnomia
12. (10 points) identify the dwarf planet which closest resembles the Haumea from the image set?Figure 8
13. (10 points) Identify Earth's moon from the image set?Figure 7
14. (10 points) Following questions are related to earth-moon tidal lock [**Tiebreaker**]
    (a) (7 points) Explain why Earth and Moon are tidally-locked? Their rotations are so in sync we only see one side of the Moon all the time.
    (b) (3 points) What is the far side of the moon? The lunar far side is the side that earth cannot see.
15. (10 points) Origin of the moon [**Tiebreaker**]
    (a) (8 points) Describe the leading theory of the Moon's origin? The leading theory of the moon's origin is that a Mars-sized body called **Theia** collided with **Proto-Earth** about 4.5 billion years ago.
    (b) (2 points) How old is the Moon?
        - ◯ about 4.5 billion years ✓
        - ◯ about 45 billion years

◯ about 1 billion years
◯ about 0.5 billion years

16. (10 points) List distinct internal layers of the Earth's Moon? The solid, iron-rich inner core; liquid iron shell; partially molten layer; The crust

17. (10 points) Identify the moon Charon from the image set?Figure 19

18. (10 points) Charon is orbiting which object? Pluto

19. (10 points) Identify the moon Mimas from the image set?Figure 16

20. (10 points) Identify the moon Phoebe from the image set?Figure 18

21. (10 points) What is a minor planet? [**Tiebreaker**] an astronomical object in **direct orbit around the Sun** that is **neither a planet nor exclusively classified as a comet**

22. (10 points) List Minor planets? asteroids, trojans, centaurs, Kuiper belt objects, and other trans-Neptunian objects

23. (10 points) Are dwarf planets same as minor planets?
    ◯ Yes
    ◯ No ✓
    ◯ They are same

24. (10 points) Identify three broad composition classes of asteroids? [**Tiebreaker**] C-, S-, and M-types

25. (10 points) What solar system object helped to create the Asteroid Belt
    ◯ Sun
    ◯ Jupiter ✓
    ◯ Mars
    ◯ None of the above

26. (10 points) How asteroids can be knocked out of the asteroid belt?
    ◯ Jupiter's gravity
    ◯ Close encounters with Mars
    ◯ All of the above ✓

27. (10 points) What is a trans-Neptunian object (TNO)? [**Tiebreaker**] **any minor planet** in the Solar System that orbits the Sun at **a greater average distance than Neptune**

28. (10 points) Identify two large groups within TNO? The Kuiper belt objects (KBOs) and The scattered disc objects (SDOs)

29. (10 points) What is a Centaurs?
    ◯ comet-like in composition
    ◯ Asteroid-like in size
    ◯ A dwarf planet
    ◯ First and second are correct ✓

30. (10 points) Identify 'Oumuamua from the image set?Figure 10

31. (10 points) What is the significance of 'Oumuamua object? [**Tiebreaker**] **The first confirmed object from another star** to visit our solar system, this interstellar interloper appears to be a rocky, cigar-shaped object with a somewhat reddish hue.

32. (10 points) Is 'Oumuamua comet or asteroid Explain based on observations? [**Tiebreaker**] **It was briefly classified as an asteroid until new measurements found it was accelerating slightly, a sign it behaves more like a comet**. So it act like both

33. (10 points) Explain how remote sensing instrument works?
    - ◯ They record characteristics of objects at a distance ✓
    - ◯ They record characteristics of objects by using its sample
    - ◯ None of the above

34. (10 points) Identify the remote sensing instrument shown in image set? Figure 21

35. (10 points) Classify spectroscopic instruments into three main categories? [**Tiebreaker**] Absorption, Emission, and Scattering spectroscopy

36. (10 points) Identify the remote sensing instrument shown in Figure 5
    - ◯ Radar imaging/Altimetry ✓
    - ◯ Electrostatic Analyzer
    - ◯ Imaging or optical Instrument
    - ◯ None of the above

37. (10 points) Identify the DAWN spacecraft from the image set?Figure 6

38. (10 points) DAWN related questions
    (a) (8 points) What is the goal of the DAWN mission? giant asteroid Vesta and dwarf planet Ceres
    (b) (2 points) What is the current status of DAWN spacecraft?
        - ◯ Still on mission
        - ◯ Gone silent ✓
        - ◯ Destroyed
        - ◯ Extended mission

39. (10 points) Identify the Voyager 2 spacecraft from the image set?Figure 22

40. (10 points) Where is Voyager 2 spacecraft?
    - ◯ Still inside the solar system
    - ◯ Entered interstellar space ✓
    - ◯ Gone silent
    - ◯ Destroyed

41. (10 points) Identify the LUCY spacecraft from the image set?Figure 13

42. (10 points) LUCY mission related
    (a) (6 points) What is the goal of the LUCY mission? explore six Jupiter Trojan asteroids
    (b) (2 points) What is the current status of the mission?
        - ◯ In Development ✓
        - ◯ In mission
        - ◯ In extended mission
        - ◯ In design
    (c) (2 points) What was/is the launch date?
        - ◯ October 2022
        - ◯ October 2021 ✓

◯ October 2012
◯ October 2001

43. (10 points) Identify the CASSINI spacecraft from the image set?Figure 23

44. (10 points) Identify the Huygens probe from the image set?Figure 9

45. (10 points) CASSINI mission related
    (a) (5 points) What is the goal of the CASSINI mission? study Saturn and its complex system of rings and moons in unprecedented detail
    (b) (5 points) What is the mission of the Huygens probe?
        ◯ Parachuted to the surface of Saturn's moon, Enceladus
        ◯ Parachuted to the surface of Saturn's moon, Titan ✓
        ◯ Free-fall to the surface of Saturn's moon, Enceladus
        ◯ Parachuted to the surface of Saturn's moon, Janus

46. (10 points) Identify the New Horizons spacecraft from the image set?Figure 17

47. (10 points) Recently New Horizons spacecraft flew past and took imagery of the most distant solar system object in history. What is it?[**Tiebreaker**] Ultima Thule

48. (10 points) New Horizons mission related [**Tiebreaker**]
    (a) (5 points) What is the goal of the New Horizons mission? New Horizons is a mission sent to study the dwarf planet Pluto, its moons, and other objects in the Kuiper Belt, a region of the solar system that extends from about 30 AU, near the orbit of Neptune, to about 50 AU from the Sun.
    (b) (5 points) What is the current status of the New Horizons mission?
        ◯ Gone silent
        ◯ Completed
        ◯ Successful - Extended Mission in Progress ✓
        ◯ Still completing the main mission

49. (10 points) Kepler's Laws
    (a) (8 points) The orbit of a hypothetical planet is shown in Figure 11 which shows the area of the orbital plane swept during a unit time T. The sun is shown in the yellow circle. what is the relation between area (A) swept during these unit time intervals (T)? it is constant
    (b) (2 points) What happens to the speed of the planet as it approaches closer to the sun from far side? Increase

50. (10 points) The semi-major axis of the orbit of this hypothetical planet is 4.642 AU where AU is the astronomical unit. Find the orbital period of the hypothetical planet in years you can use the plot shown in Figure 12?
    ◯ 100 years
    ◯ 1 year
    ◯ 10 year ✓
    ◯ 1000 years

51. (10 points) Tides
    (a) (5 points) What causes tides?
        ◯ To a greater extent by the moon
        ◯ To a lesser extent by the sun
        ◯ All of the above ✓

(b) (5 points) Identify two types of tides from Figure 20 Top and middle are Spring tide and bottom one is Neap tide

52. (10 points) Moon phases [**Tiebreaker**]
    (a) (5 points) The Moon passes through two distinct parts of Earth's shadow during a lunar eclipse. What are they called? The penumbra. The umbra
    (b) (5 points) Explain their differences? **The outer part of the shadow is called the penumbra**. The penumbra is less dark than the inner part of the shadow because it's penetrated by some sunlight. **The inner part of the shadow, known as the umbra**, is much darker because Earth blocks additional sunlight from entering the umbra.

53. (10 points) Identify two distinct parts of the earth's shadow in the Figure 14 [**Tiebreaker**] **The outer part of the shadow in the image is called the penumbra**. **The inner part of the shadow is known as the umbra**

54. (10 points) Lunar Eclipses [**Tiebreaker**]
    (a) (5 points) How lunar eclipses occur? A lunar eclipse occurs when the moon passes through the Earth's shadow
    (b) (5 points) why don't eclipses happen once a month? The reason is that the Moon's orbit around **the Earth is tilted relative to the Earth's orbit around the Sun**.

55. (10 points) Identify moon phases from top to bottom in Figure 24 [**Tiebreaker**] Waxing Crescent, first quarter, waxing gibbous, full moon, waning gibbous, last quarter, and waning crescent

56. (10 points) Solar eclipses
    (a) (2 points) How solar eclipses occur? When the Moon's shadow covers part of the Earth
    (b) (4 points) At what moon phase a solar eclipse can occur? Only happens at New Moon
    (c) (4 points) List three types of solar eclipse Annular, Partial, and Total

1 Figure Captions

- Figure 1 Ceres
- Figure 2 Eris
- Figure 3 Pluto
- Figure 4 Ceres Internal
- Figure 5 Radar Altimetry
- Figure 6 DAWN
- Figure 7 Earth Moon
- Figure 8 Haumea
- Figure 9 Huygens
- Figure 10 Oumuamua
- Figure 11 Kepler-2nd-law
- Figure 12 Kepler-3rd-law
- Figure 13 LUCY

2019 National Science Olympiad B Division Solar System Event Image Set

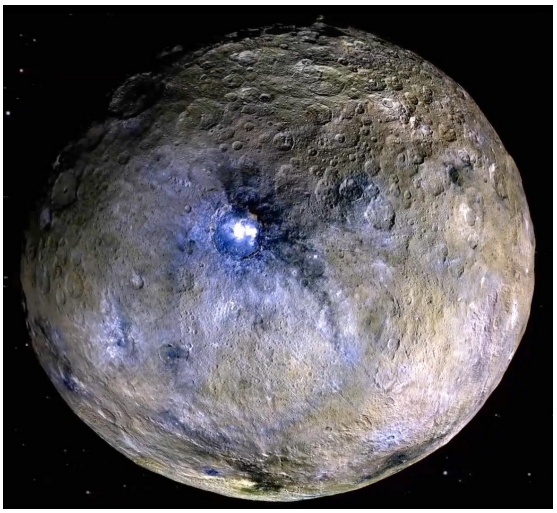


Figure 1:

Figure 3:

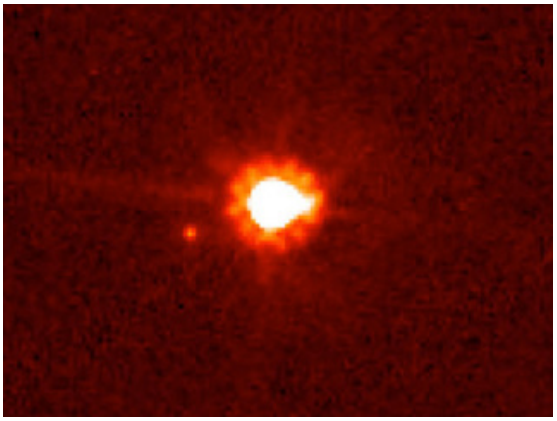
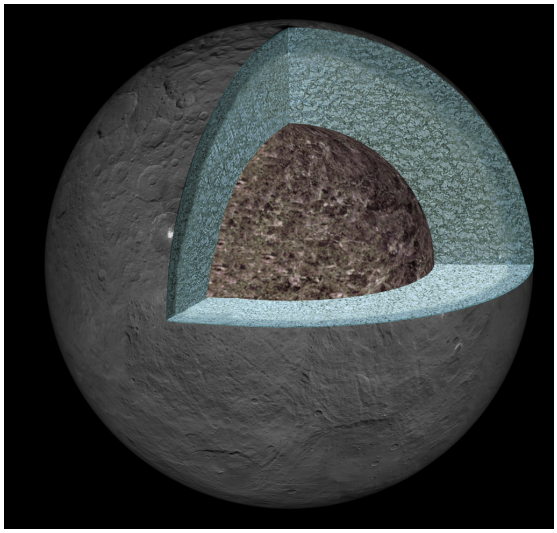


Figure 2:



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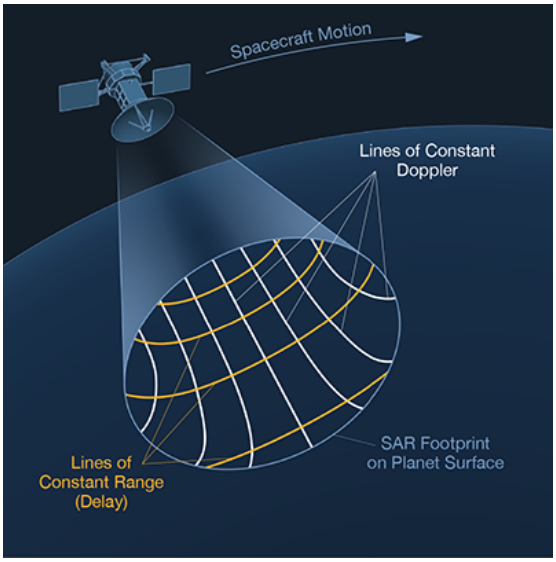

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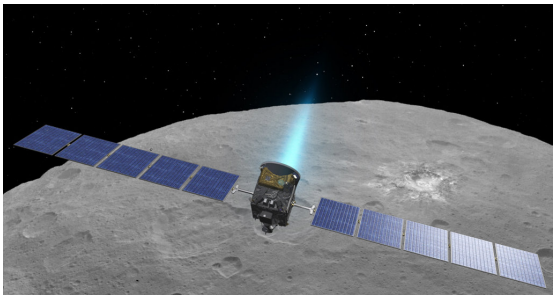
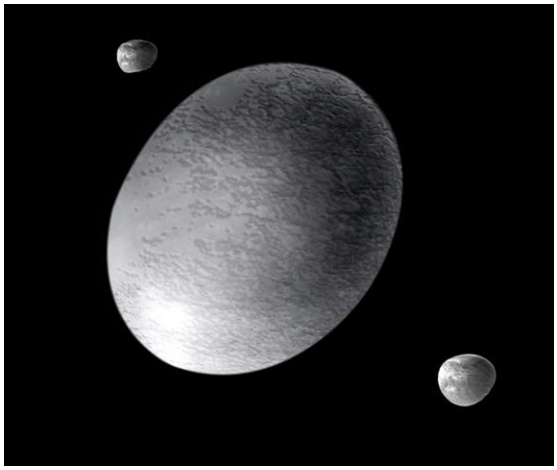


Figure 6:

Figure 7:



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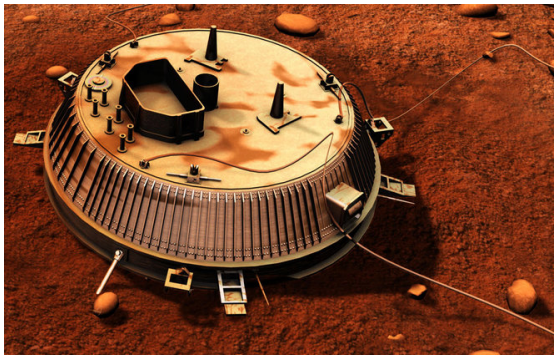

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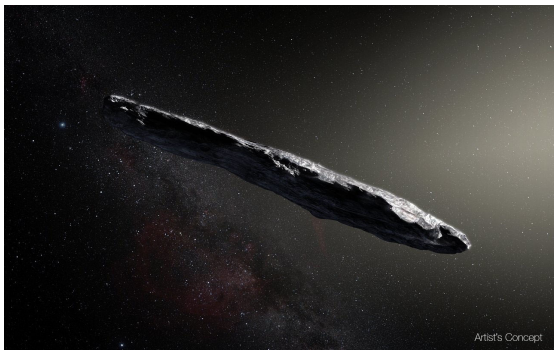


Figure 10:

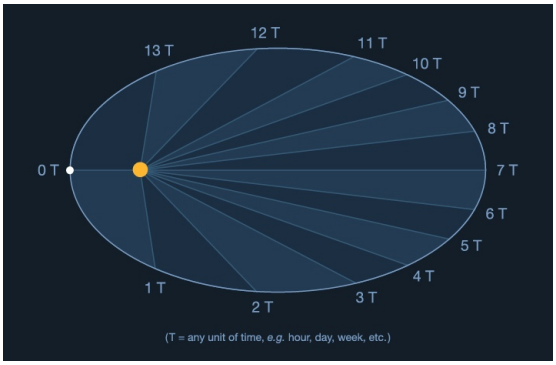


Figure 11:

Figure 14:

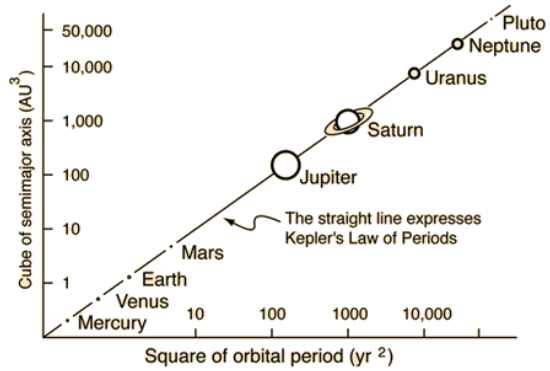


Figure 12:

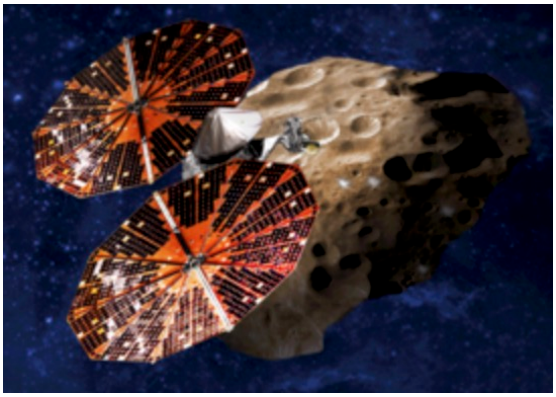


Figure 13:

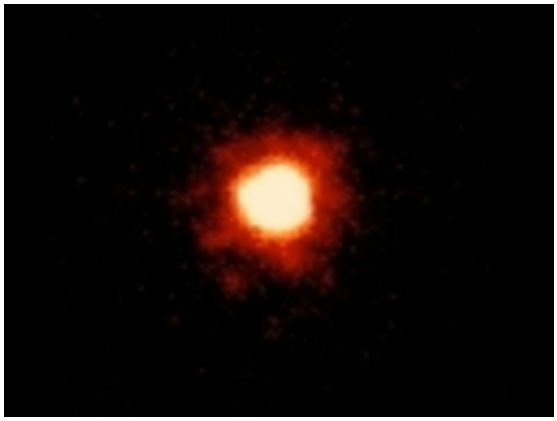
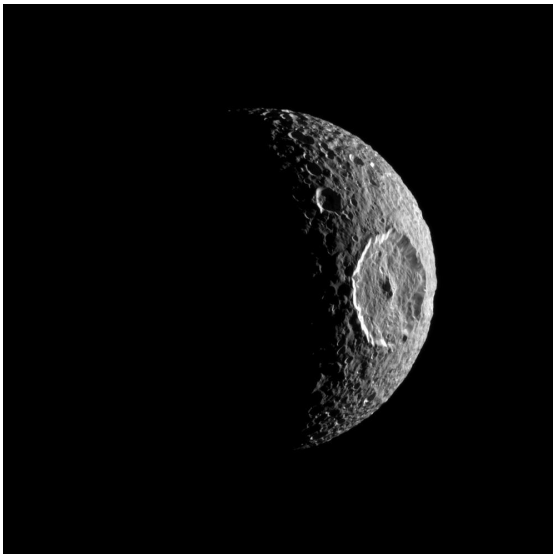


Figure 15:



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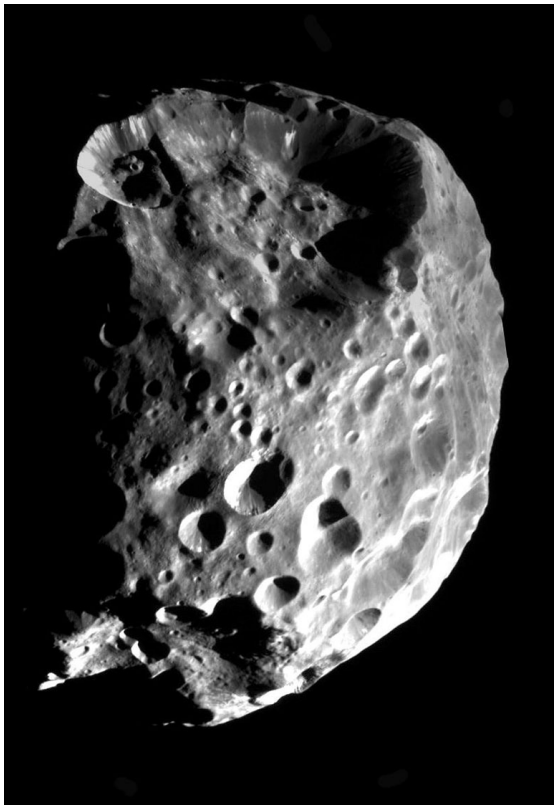

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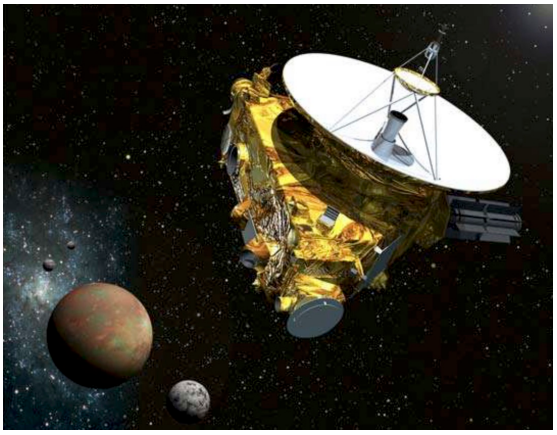
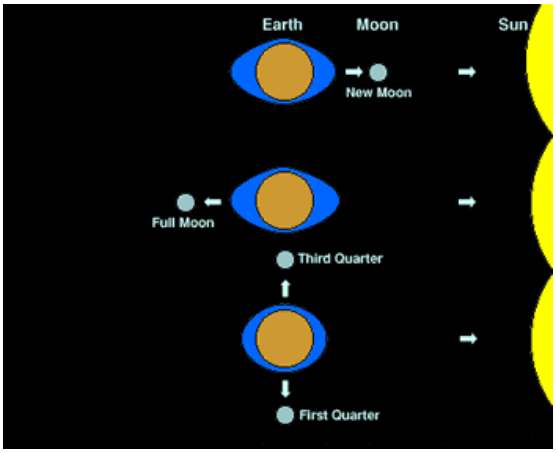


Figure 17:

Figure 19:



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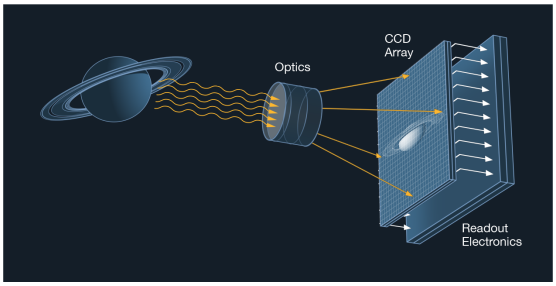

Figure 21:

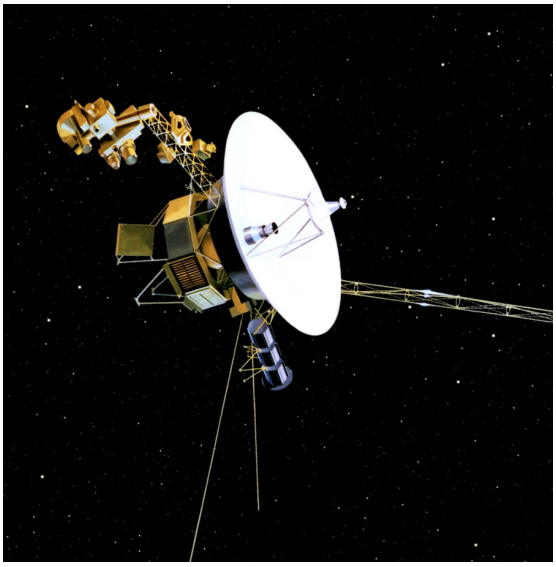

Figure 22:

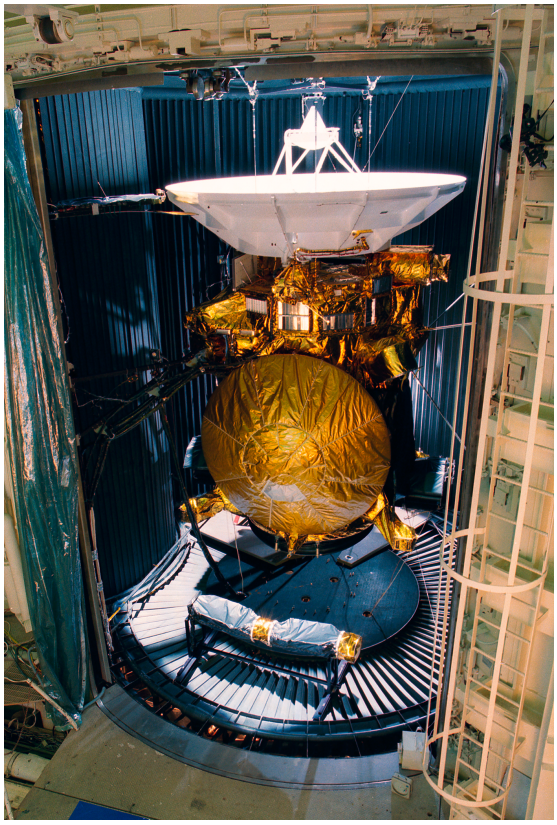

Figure 23:

Figure 24: