



SCIENCE OLYMPIAD
— AT THE —
UNIVERSITY OF FLORIDA

Northern Regional: January 19th, 2019

Solar System B Answer Key

Name(s): _____

Team Name: _____

School Name: _____

Team Number: _____

Rank: _____

Score: _____

Answer Key

Part I: Written Test

Dwarf Planets

1. A minor planet that "has sufficient mass for its self-gravity to overcome rigid-body forces so that it assumes a hydrostatic equilibrium or nearly round shape". (1 pt)
2. Eris, Pluto, Haumea, Makemake, Ceres (3 Points: All or nothing)
3. Ceres, Pluto, Haumea, Makemake, Eris (3 Points: All or nothing)
4. A minor planet is any object in the solar system that is classified neither as a planet or comet and directly orbits the Sun. (1pt)
5. Ceres (1pt)
6. C (1pt)
7. Haumea; rotational period 4 hours; Hi'iaka and Namaka (4 pts)
8. Makemake; one moon; Kuiper Belt (3 pts)
9. Ceres; orbits the Sun once every 4.6 Earth years; its day is about 9 hours. (3 pts)
10. Eris; methane ice; one moon (3pts)
11. Pluto; frozen nitrogen; Pluto is defined by many notable geologic features, including **Sputnik planitia** and the **heart-shaped Tombaugh region**. (4 pts)
12. C (1pt)
13. The Bright spots on the surface known are known as **faculae** and are composed of **highly reflective salt** which may be indicative of hydrogeological activity on **Ceres**. (3 pts)
14. Plutoids, or "ice dwarfs" are dwarf planets that are found outside the orbit of Neptune. Scientists suspect there that there may be up to 200 objects plutoids in the solar system. **Four** officially exist. (3 pts)
15. Charon, Styx, Nix, Kerberos, and Hydra. (5 points for the names, 2 extra for the correct order. 7pts total)
16. Hydrostatic equilibrium = meaning it has a static distribution of differentiated layers in interior based on layer density; Haumea (2pts)

17. Pluto completes two orbits in the time it takes Neptune to complete three. (1pt)

Satellites

18. Answers: (13 total points)

- a. Mare Imbrium / Imbrium Basin (1 point)
- b. Near the end of heavy bombardment (1 point), a planetesimal struck the moon and blasted out a giant multi ringed basin. Lava flows then flooded the basin, burying all but the highest parts (1 point).
- c. The terminator (1 point)
- d. The same side of the moon faces Earth at all times (1 point)
- e. Large-Impact Hypothesis (1 point for something similar); a protoplanet nearly the size of Earth differentiates to form an iron core. Another body that has also formed an iron core strikes the larger body and merges, trapping most of the iron inside (1 point). Iron-poor rock from the mantles of the two bodies forms a ring of debris (1 point). Volatiles are lost to space as the particles in the ring begin to accrete into larger bodies. Eventually the moon forms from the iron-poor and volatile-poor matter in the disk (1 point).
- f. Hypothesis:
 - i. Fission Hypothesis: The material that left the Earth would most likely result in the Pacific Ocean forming, but the Moon is made up of mantle material, not oceanic crust (1 point).
 - ii. Condensation Hypothesis: The moon does not possess a significant iron core (1 point).
 - iii. Capture Hypothesis: Capture into the moon's current orbit is improbable. Also, the lunar material received extra baking which cannot be explained by this hypothesis (1 point).
- g. Much of the lunar crust was fractured by meteorite impacts (1 point).

19. Self-gravitation (1pt)

20. Indicates that it is composed mostly of water ice with only a small amount of rock. (1pt)

21. That may indicate a nonspherical core or a global subsurface ocean. (1pt)

22. May also indicate a subsurface ocean. (1pt)

23. Herschel (1pt)

24. It orbits Saturn in a **retrograde** orbit. (1pt)

25. Pluto and Charon are gravitationally locked, meaning the same sides always face one another. (1pt)

General Details of other small Bodies (all 1pt unless otherwise specified)

26. M-type Asteroid
27. C-type Asteroid
28. S-type Asteroid
29. Asteroid Belt's "Kirkwood Gaps" occur at distances between Mars and Jupiter where no gravitationally stable orbits exist.
30. "Nebular Hypothesis"
31. A Trans-Neptunian object or TNO is a minor planet in the Solar System that orbits the Sun with larger semi major axis than Neptune or 30 astronomical units.
32. Extreme trans-Neptunian objects or ETNOs are those that have a semi-major axis greater than 150 astronomical units and perihelion greater than 30 astronomical units.
33. 2007 OR₁₀
 - a. The scattered disc
 - b. One
 - c. Locked in a 3:10 resonance; with Neptune (2pts)
 - d. Atmospheric nitrogen
 - e. Cryovolcanism
34. Centaurs are objects in the solar system that orbit *within* the orbit of Neptune and cross the orbits of one or more of the gas giant planets. / are minor planets having perihelion greater than 5.2 AU and aphelion less than 30.1 AU.
35. A Trojan is a minor planet or moon that shares the orbit of a planet or larger moon, wherein the Trojan remains in the same, stable position relative to the larger object.
36. L₄ and L₅
37. Announced by NASA in 2011, named 2010 TK7 (2pts)
38. 2017
39. Interstellar
40. It is colored **red** like Kuiper belt objects, possibly because of exposure to cosmic rays. (2pts)

Part II: Hands-On/Interpretive Task (all 1pt unless otherwise specified)

41. August 20, 1977
42. Jupiter, Saturn, Uranus, and Neptune (2pts for all correct, 1 point if they get at least 2 correct)
43. 6
44. New Horizons; January 19, 2006 (2pts)
45. Jupiter; observed newly formed Little Red Spot (2pts)
46. Cassini; October 15, 1997 (2pts)
47. Successful **Saturn orbiter** and **Titan probe** (2pts)
48. New Horizons
49. Dawn; September 27, 2007 (2pts)
50. Lucy; a flyby mission that will **tour six Jupiter Trojans** (2pts)