

**Science Olympiad
Planetary Science B Division Event
Sample State Exam: 2013**



TEAM NUMBER: _____

TEAM NAME: _____

INSTRUCTIONS:

- 1) Please turn in ALL MATERIALS at the end of this event.**
- 2) Do not forget to put your TEAM NAME and TEAM NUMBER at the top of all Answer Pages.**
- 3) Good Luck! And May the Planets align for You!**

Part 1

1. Which of Mars' polar caps is shown in Image A?

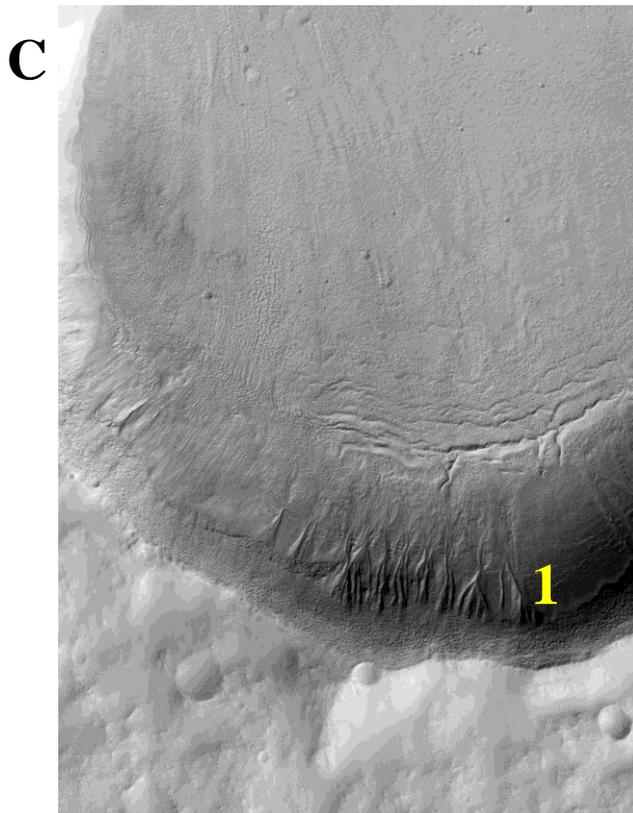
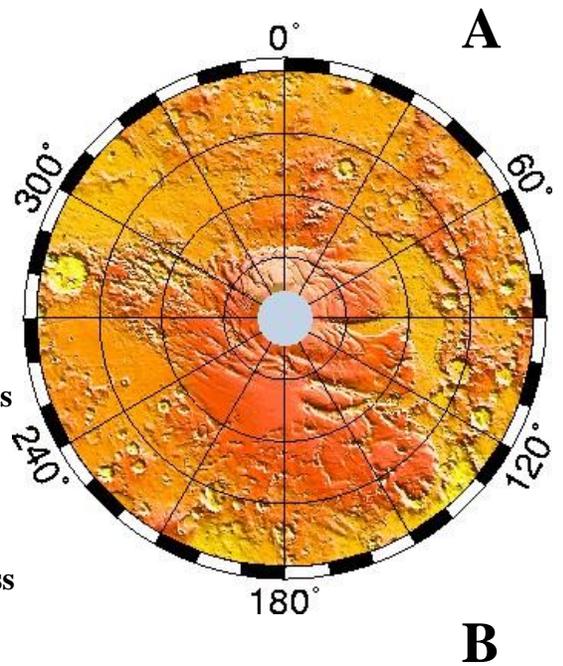
2. Does this cap have more or less seasonal ice than Mars' other polar cap?

3. Image B, taken by the HiRISE instrument on the Mars Reconnaissance Orbiter, shows a seasonal process that occurs at the polar cap shown in Image A. During which Martian season does this process occur?

4. What features on Earth is this process most similar to?

5. What is the key difference between this Martian process and its analog that occurs on Earth?

6. Another Earth-analog feature on Mars is displayed in Image C below. What feature is seen at point 1 in the figure?



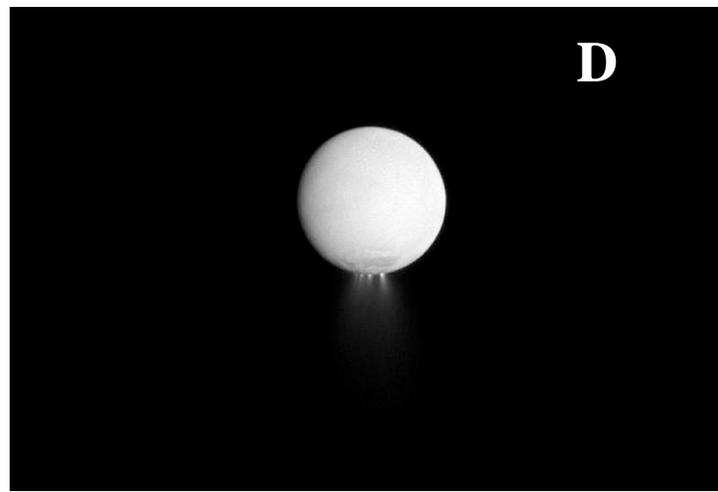
7. What larger feature are these small-scale features embedded in?

8. What is a plausible mechanism for forming these features?

9. Which Solar System body is displayed in Image D?

10. What is the name for the jets emanating from the bottom of the body in the image?

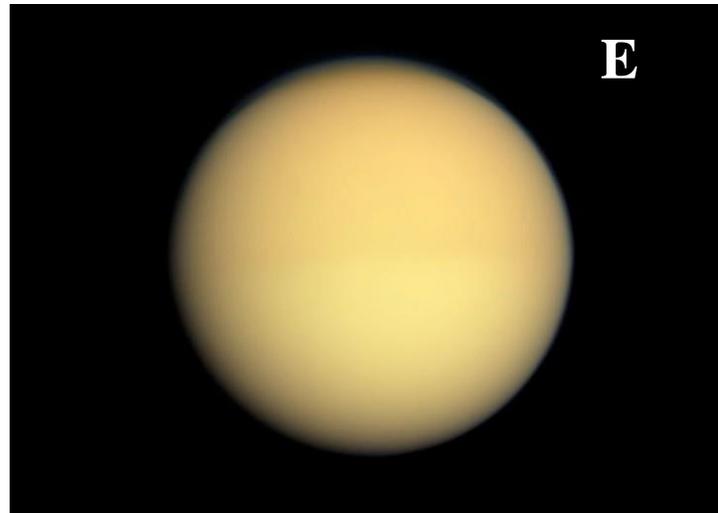
11. These jets have a variable intensity throughout this body's orbit. What causes this variation?



12. Which moon of Saturn is shown in Image E?

13. This moon's bulk density is approximately 1.9 g/cm^3 . What does this imply for the existence of water on the moon?

14. Lakes exist on this moon, but they are not made of water. What other compound is the major constituent of these lakes?



15. An artist's conception of a spacecraft that will visit Ceres is shown in Image F. What is the name of this unmanned NASA spacecraft?

16. Which other Solar System body was this spacecraft the first craft to visit, with a flyby in 2012?



17. The mass of Ceres is $9.5 \times 10^{20} \text{ kg}$, and Ceres has a mean radius of 470 km. What is the density of Ceres, in g/cm^3 ?

18. In which of the following regions of the Solar System does Ceres reside?

- a) Kuiper Belt
- b) Asteroid Belt
- c) Oort Cloud
- d) Jupiter Trojans
- e) Centaurs

19. Ceres is located 2.75 AU from the Sun. The maximum temperature of Ceres' surface is 235 K. Is this above or below the triple point of water?

20. What is the hypothesized region of space between our Solar System and neighboring systems which is believed to be the source of all long-period comets?

21. Voyager 1 is believed to have passed the heliopause in August 2012. Has Voyager 1 entered the region of space from Question #20 as of September 2013?

22. Which body is the most massive object in the Kuiper Belt?

23. Haumea is the 3rd-brightest object in the Kuiper belt. How has its rotational period been constrained?

24. Which spacecraft studied the interior of comet 9P/Tempel through releasing an impactor into the comet?

25. What planned asteroid sample return mission will launch in 2016 and return to Earth in 2023 with samples of the asteroid Bennu?

26. Which region of Europa is shown in the false-color Image G?

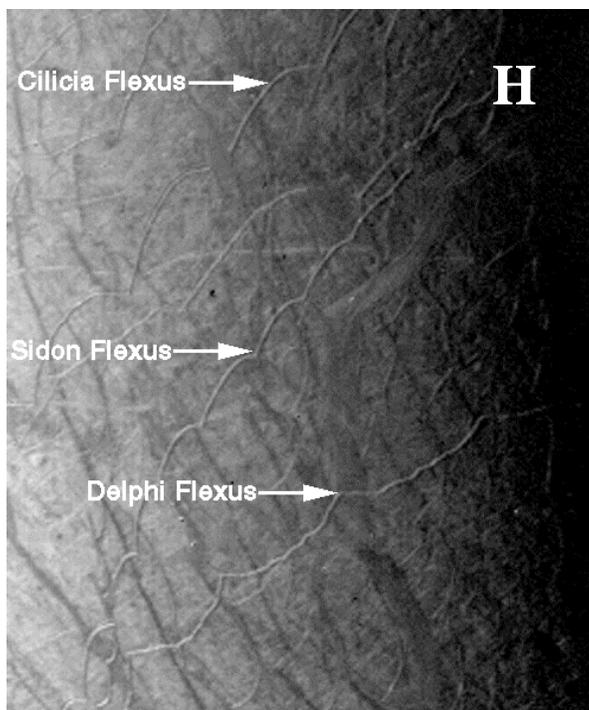
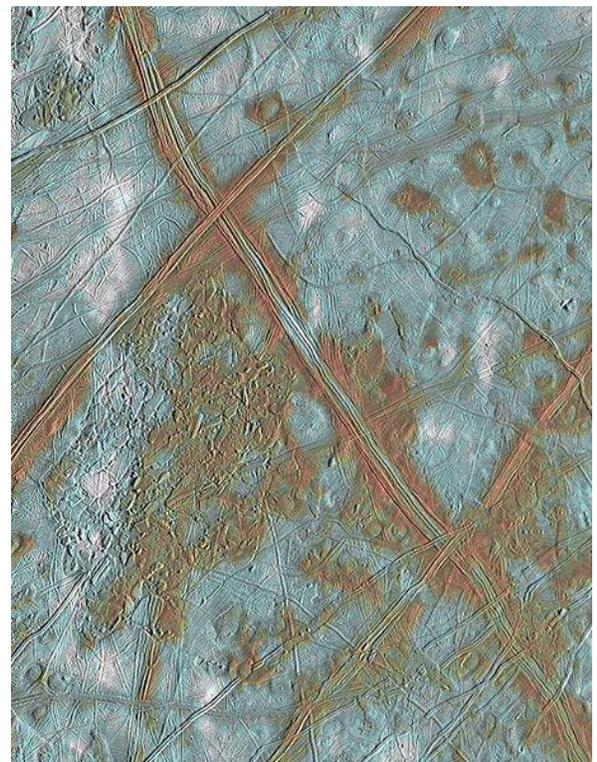
27. How is this blocky terrain thought to have formed?

28. Which NASA mission has provided most of our current data on Europa?

29. Which features on Europa are shown in Image H?

30. What is the likely cause of these surface features?

G



Part II

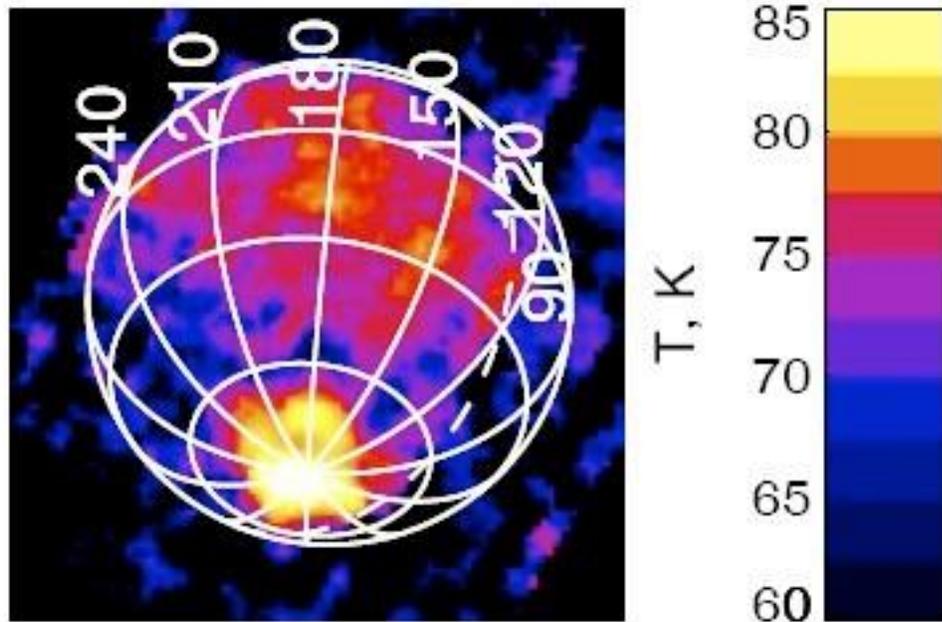


Figure 1: Temperature map of Enceladus from Cassini

- 31. Which instrument on NASA's Cassini mission took the temperature map shown in Figure 1 above?
- 32. Does this instrument probe wavelengths that are longer or shorter than those we can see with our own eyes?
- 33. The heat radiating from the South pole of Enceladus is concentrated along fractures. What are these fractures called?
- 34. What emanates from these fractures?

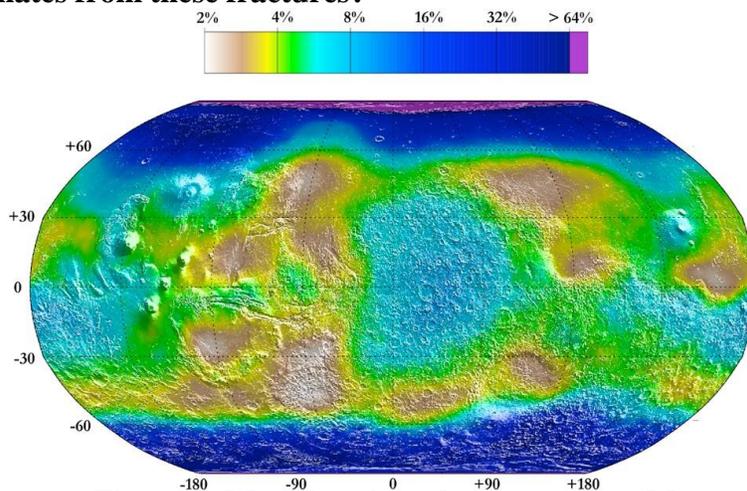


Figure 2: Mass fraction of compound on Mars

- 35. The mass fraction of which compound is shown in Figure 2?
- 36. Which NASA spacecraft took the measurements that made this image?
- 37. What is used as a proxy for the measured compound?

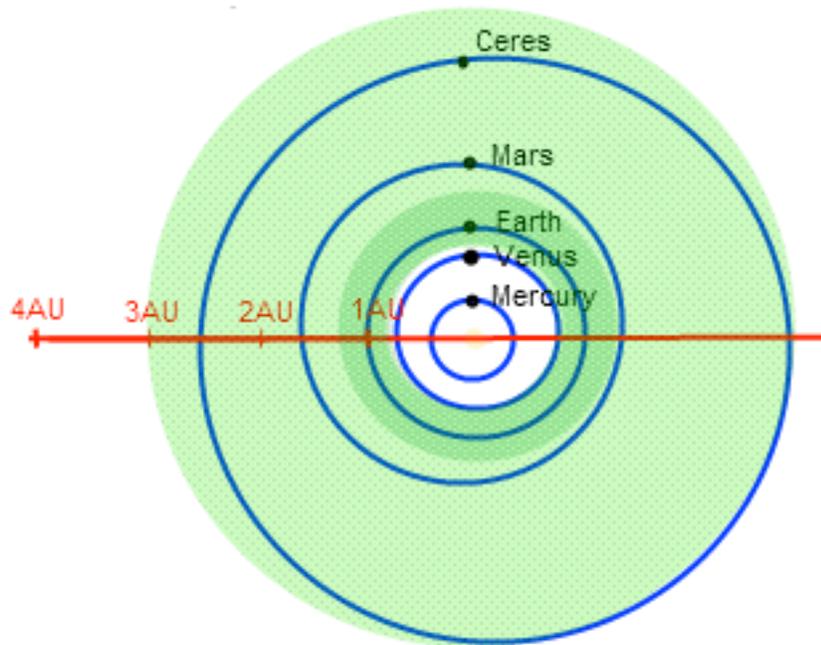


Figure 3: Plot of Solar System with green overlay

38. What is the name for the region overlaid on the planetary orbits shown in Figure 3?
39. What does this say about the surface temperatures of the planets within this region?
40. True or False: This region would extend farther out if the Sun was less luminous.
41. What is the name for the region of the Solar System around 5 AU where ice begins to be able to condense into solid grains?

Match the following terms to the corresponding description.

- A. Dwarf Planet B. Triple point of CO₂ at 1 atm pressure C. Comet
 d. Triple Point of CH₄ at 1 atm pressure E. Triple point of H₂O at 1 atm pressure
 F. Kuiper Belt G. Ocean H. Ridges I. Tiger Stripes J. Valles Marineris
 K. Conamara Chaos L. Thrace Macula M. Asteroid Belt N. Oort Cloud

42. Icy Solar System body that displays coma and sometimes tail when in vicinity of Sun.
43. Subsurface water region believed to be found on Europa and Titan.
44. Pluto and Ceres are members of this class of objects.
45. 195 Kelvin.
46. Compressional structures found on the surface of Europa.
47. Largest dark spot on Europa.
48. Feature displayed on cover page of event.
49. Region extending from 30-50 AU from the Sun.
50. Region split by Kirkwood gaps.