

The Martian map used in this activity may be purchased from Other Worlds Educational Enterprises. See <http://www.otherworlds-edu.com>

Part I: Kepler's Laws of Planetary Motion

1. **Second**
2. **Second**
3. **Point D**
4. **B**
5. **Closer together**
6. **C**
7. **D**
8. **Major axis**
9. **Semimajor axis**
10. **Third**
11. **Third**

Part II: Atmosphere, Temperature, and Seasons

12. **Perihelion**
13. a. **Southern**
b. **~ 333 days**
14. a. **longer**
b. **Shorter**
c. **Southern**
15. **Carbon dioxide has a much lower freezing point.**

Answer Key

16. **Atmospheric pressure increases as CO₂ sublimates; and decreases as it condenses back into snow and ice.**
17. **High**
18. **Low**
19. **a (areas of high pressure to areas of low pressure)**
20. **North to south**
21. **Mars is closest to the Sun at perihelion. At this time, the Sun's energy heats the southern atmosphere a bit more thus increasing the temperature range between the northern and southern hemispheres. This greater difference in temperatures creates stronger winds sometimes resulting in planet-wide dust storms.**
22. **c (or "distance from the Sun")**
23. **b (or "orbital eccentricity")**
24. **The atmosphere is most dense at low elevations.**
25. **Southern**
26. **Northern**
27.
 - a. **Since the poles are composed of CO₂ and H₂O and CO₂ is first to sublime, the atmosphere will become richer in CO₂. CO₂ is a greenhouse gas. The atmosphere will become warmer should the trend of a decrease in the size of the Martian poles continue for an extended period of time.**
 - b. **Earth's polar icecaps are also shrinking. This shrinking may be at least partially responsible for increased global warming on Earth.**
28.
 - a. **Northern**
 - b. **Counter-clockwise direction of the spinning cyclone as indicated by the direction of the spiral pattern in the clouds**
 - c. **Coriolis effect**

Answer key

Part III: Geologic Activity and Features

29. There were a finite number of large solid bodies available, i.e. the more of these large solid bodies that impacted the surface, the fewer remained to continue the same rate of impact.
30. Comet nuclei and asteroids
31. Asteroid Belt, Kuiper Belt, Oort Cloud
32. Possible responses: density (number of craters per given equal areas); amount of erosion; height (gravity eventually “pulls” them downward thus reducing their overall height)
33. b and c (3 points for both correctly answered; 1 point for one)
34. a. Argyre Planitia (Utopia Planitia and Thaumasia are also impact
b. Hellas Planitia basins, however it’s doubtful that participants will
c. Isidis Planitia identify these as impact basins.)
35. Hellas Planitia
36. Ceres
37. a
38. d (Only statements “a” and “c” are true.)
39. Possible responses: Their walls are very sharp and well-defined or eroded very little.
40. Possible responses: (1) By the time these lava plains had formed, few large solid bodies remained floating about the solar system to impact the surface. (2) The ancient surfaces containing the larger craters of more ancient times had been covered by lava flows.
41. By the time these lava plains had formed, the vast majority of solid bodies, both large and small, floating freely about the solar system had already impacted the planets and their satellites.
42. Amazonian

Answer Key

43. Noachian
44. Hesperian
45. 3000 ± 500 meters
46. Possible responses: (1) The number and size of the volcanoes in this area as compared to other areas. (2) Possibly the uplift associated with this area.
47. Possible responses: a much larger base; (2) flattened; (3) surrounded by a circular pattern of fracture; (4) lies at a lower elevation than its surroundings
48. Mars does not have plate tectonics. Martian volcanoes remained over the very same hot spot permitting these volcanoes to grow to immense sizes. (or low gravity for 1 point)
49. The relatively small size of Planet Mars itself results in its having a much smaller gravitational attraction. Less gravity to pull it downward permitted the volcano to grow to an immense size.
50. b (much closer to you)
51. The other side is below the horizon.
52. a (an early Martian space mission)
53. a. The islands may have been shaped by flowing water.
- b. The valleys may once have been formed by rivers flowing from high elevations to lower elevations.

54. Participant ratings on difficulty: Top NSO 2007 Scores (out of 117 pts.)

a. Much too difficult	10	1 st place:	102.0
b. Challenging, but fair	30	2 nd place:	96.0
c. Relatively easy	0	3 rd place:	92.5
d. Much too easy	0	4 th place:	91.0
e. No response	20	5 th place:	89.0
		6 th place:	88.5

Participant comments:

- Extremely challenging, however, appropriate for such a competition involving the best of our nation's students.
- This was one of the better astronomy tests I have taken.
- I did not expect questions on climate information about Mars, but a very interesting and fun test! Thanks so much.
- Hi, I think it was soooooo fun!!!
- It was very well written.