

PROBLEM SET 11

Physics 2021

1. From the 2007 opposition of Mars to the 2010 opposition, how many orbits around the Sun does the Earth complete? How many orbits does Mars complete? (Your answers will *not* be whole numbers.)
2. When Mars is at opposition, what is its phase as seen from the Earth? What is the Earth's phase as seen from Mars? Explain with a diagram.
3. (a) The Grand Canyon in Arizona was formed over 15 to 20 million years by the flowing waters of the Colorado River, as well as by rain and wind. Contrast this formation scenario to that of Valles Marineris. (b) Valles Marineris is sometimes called "the Grand Canyon of Mars." Is this an appropriate description? Why or why not?
4. Is it reasonable to suppose that the polar regions of Mars might harbor life-forms, even though the Martian regolith is sterile at the *Viking Lander* sites? Explain.
5. The orbit of Phobos has a semi-major axis of 9378 km. Use this information and the orbital period given in the text to calculate the mass of Mars.
6. Calculate the angular sizes of the two Martian moons Phobos and Deimos as they pass overhead, as seen by an observer standing on the Martian equator. How do these sizes compare with that of the Moon seen from the Earth's surface? Would Phobos and Deimos appear as impressive in the Martian sky as the Moon does in our sky?
7. The distance between the Earth and Mars when the two planets are at opposition varies greatly because of the large eccentricity of Mars' orbit. The perihelion distance of a planet is given by $r_{min} = a(1 - e)$ and the aphelion distance by $r_{max} = a(1 + e)$, where a is the semi-major axis and e the orbital eccentricity. Find the smallest and largest opposition distances assuming the Earth's orbit is a circle.
8. At an average opposition, the Earth and Mars are separated by 0.52 AU. Suppose an astronomer observes Mars at opposition and that seeing blurs the images to a resolution of 1.0 arcseconds. What is the smallest surface feature the astronomer would be able to resolve on Mars? How does this size compare with the diameter of Mars?
9. (a) Suppose you have a telescope with an angular resolution of 1 arcsec. What is the size (in kilometers) of the smallest feature you could see on the Martian surface during an opposition (use a distance of 88.1 million km)? (b) Suppose you had access to the Hubble Space Telescope, which has an angular resolution of 0.1 arcsec. What is the size (in kilometers) of the smallest feature you could see on Mars with the HST during an opposition?