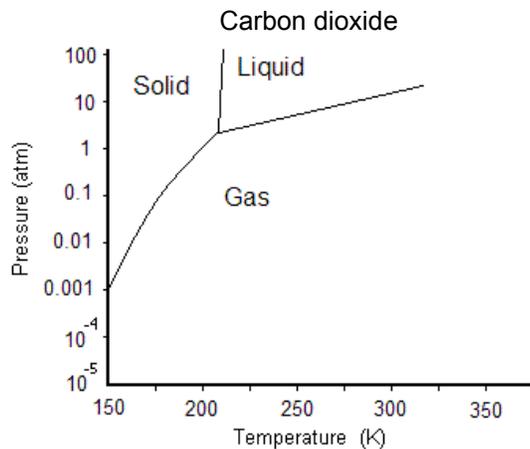
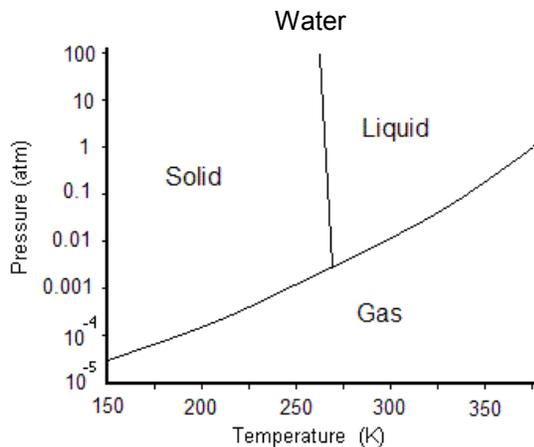


Mars: The Red Planet

1. Mars goes around the Sun once every 1.9 Earth-years. However, you may have read in the papers that in fall of 2003 it was closer to Earth than at any time in tens of thousands of years. Draw a diagram to explain this apparent contradiction.
2. Earth's seasons have nothing to do with its slightly elliptical orbit. But Mars's orbit is quite elliptical. Explain with a diagram how this affects seasons in Mars's northern hemisphere (which is tilted away from the Sun near perihelion) and Mars' southern hemisphere (which is tilted towards the Sun near perihelion.)
3. Below are phase diagrams for water and carbon dioxide, showing the regions of pressure in temperature for which each substance is solid, liquid, or gas.



- a) Identify the region on each diagram corresponding to Earth. What phases of water are stable on Earth? What phases of CO_2 are stable?
- b) Identify the region corresponding to Mars, with a surface temperature ranging from -220°C to $+20^\circ\text{C}$ and a surface pressure ranging from 0.006 to 0.01 atmospheres. What phases of water are stable? What phases of CO_2 are stable?

4. Name at least three forms of evidence for the existence of past liquid surface water on Mars. Where, and in what form, is the water there now?

5. List a few ways in which the terrain in the northern and southern hemispheres of Mars are different.

6. Astronauts returned samples of Moon rock to Earth in the 1960s and 1970s. Astronauts have yet to get anywhere near Mars, but we do have samples of Mars rock here on Earth as well. How did they get here?

7. Are there still tectonic processes (volcanism, etc.) occurring at the surface of Mars?

8. Olympus Mons is larger than any mountain on Earth, even though Mars is a smaller planet. Why is it that mountains on a smaller planet than our own are larger than those here?

9. A mission to Mars poses immense challenges far beyond those experienced in going to the Moon. List some of them.