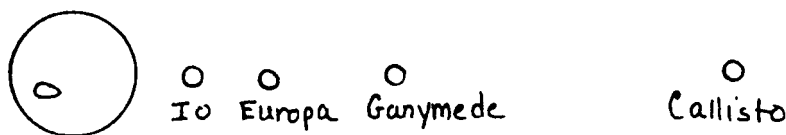


## Challenge Exercises for Further Study

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- B-1:** At what distance from Earth's center must a spacecraft be in order to experience the same gravitational attraction from both Earth and the moon when directly between the two? ( $M_E = 5.98 \times 10^{24}$  kg,  $M_M = 7.35 \times 10^{22}$  kg  $d_{E-M} = 3.84 \times 10^8$  m)
- B-2:** Jupiter's innermost Galilean satellite, Io, is covered with active volcanoes, which exist because of the immense gravitational tugging on the satellite by Jupiter and the other moons near Io. Io orbits  $4.2 \times 10^8$  m from the center of Jupiter. The other Galilean satellites are located as follows from Jupiter's center. Europa:  $6.7 \times 10^8$  m, Ganymede:  $1.0 \times 10^9$  m, and Callisto:  $1.9 \times 10^9$  m. If Jupiter and its satellites are lined up as shown, what gravitational force does the satellite Io experience? ( $M_I = 8.9 \times 10^{22}$  kg,  $M_E = 4.9 \times 10^{22}$  kg,  $M_G = 1.5 \times 10^{24}$  kg,  $M_C = 1.1 \times 10^{23}$  kg,  $M_J = 1.9 \times 10^{27}$  kg)



- B-3:** Saturn's satellite, Titan, orbits the planet in a little less than 16 days. Titan orbits Saturn at an average distance of  $1.216 \times 10^9$  m from the center of the planet. Use this information to find the mass of Saturn.