

(1) What fraction of the moon's path about the sun is convex toward the sun?

The sun attracts the moon with a force which, if the earth were absent, would keep the moon on a circular orbit of period 1 year and radius  $1.5 \times 10^{13}$  cm. The earth attracts the moon with a force which, if the sun were absent, would keep the moon on a circular orbit of period 1 month and radius  $4 \times 10^{10}$  cm. When the moon is directly between the earth and the sun the ratio of the sun-ward force to the earth-ward force is approximately  $(1.5 \times 10^{13} / 4 \times 10^{10})(1/13)^2$ , which is greater than 1. Hence that bit of the moon's trajectory must be concave toward the sun, and if it is, no other part of the trajectory could be convex to the sun. The answer is *zero*.