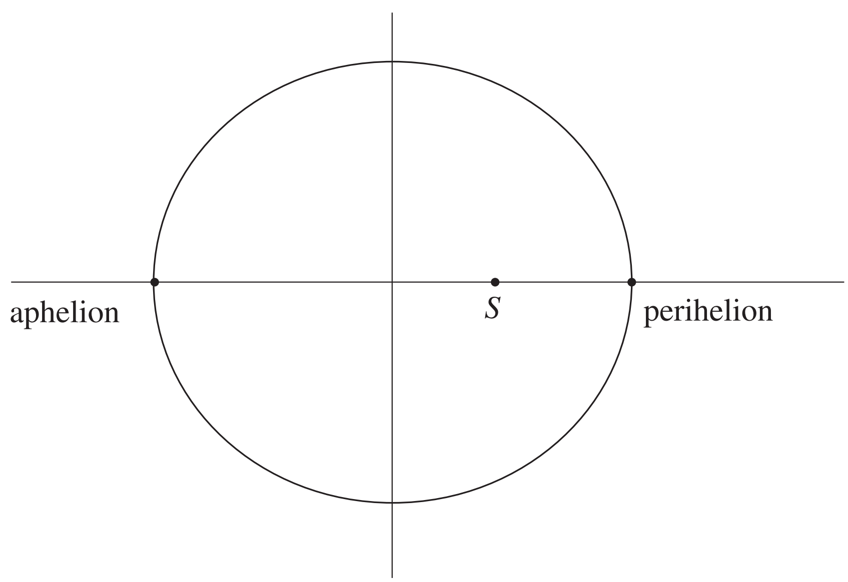
Quiz **Name**

1. Suppose that Mars in its orbit around the Sun S reached its perihelion position exactly $t = 200$ days ago. This assumption establishes the day as the basic unit of time. Angles are specified in radians. Use the data of the table below, work with 4 decimal accuracy, and include four decimal places in your answers.

a. Compute β_1.

b. Determine the angle $\beta(t)$ by finding the stable value β_i that the approximation scheme $\beta_{i+1} = \frac{2\pi t}{T} + \varepsilon \sin(\beta_i)$ converges to.

c. Compute the corresponding angle $\alpha(t)$ and find the distance $r(t)$ in km. Locate the position of Mars on the ellipse below. (Note that Mars's orbit is more circular than depicted in the figure.)



d. What is the velocity $v(t)$ of Mars in km/sec at that time?

Orbital Data of Planets					
Planet	semimajor axis in million km(1)	period of the orbit in years(2)	eccentricity	angle of orbital plane to Earth's	average speed in km/sec(3)
Mercury	57.9092	0.2408	0.2056	7.00°	47.36
Venus	108.2095	0.6152	0.0068	3.39°	35.02
Earth	149.5983	1.0000	0.0167	0.00°	29.78
Mars	227.9438	1.8809	0.0934	1.85°	24.08
Jupiter	778.3408	11.8622	0.0484	1.31°	13.06
Saturn	1426.6664	29.4577	0.0557	2.49°	9.64
Uranus	2870.6582	29.4577	0.0557	2.49°	6.87
Neptune	4498.3964	29.4577	0.0557	2.49°	5.44

1) If the interest is in au, use the conversion 1 au = 149,597,892 km.
2) If the interest is in Earth days, use the conversion 1 year = 365.259636 Earth days.
3) There are (24)(60)(60) = 86,400 seconds.

Some relevant Formulas:

$b = \sqrt{a^2 - c^2} \qquad \varepsilon = \frac{c}{a} \qquad \text{Area} = ab\pi \qquad \kappa = \frac{A_t}{t}$

$x = r\cos\theta,\ \ y = r\sin\theta,\ \ \tan\alpha = \frac{b\sin\beta}{a(\cos\beta - \varepsilon)}$

$r(t) = a(1 - \varepsilon\cos\beta(t)),\ \tan\frac{\alpha(t)}{2} = \sqrt{\frac{1+\varepsilon}{1-\varepsilon}}\tan\frac{\beta(t)}{2}$

$\beta(t) - \varepsilon\sin\beta(t) = \frac{2\pi t}{T},\ \ \beta_1 = \frac{2\pi t}{T},\ \ \beta_{i+1} = \frac{2\pi t}{T} + \varepsilon\sin(\beta_i),\ \ |\beta - \beta_i| \leq \varepsilon^i$

$v(t) = \frac{2\pi a}{T}\sqrt{\frac{2a}{r(t)} - 1}$