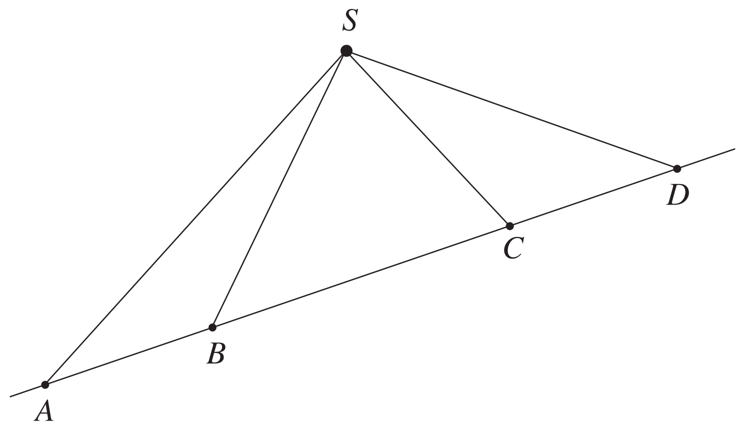
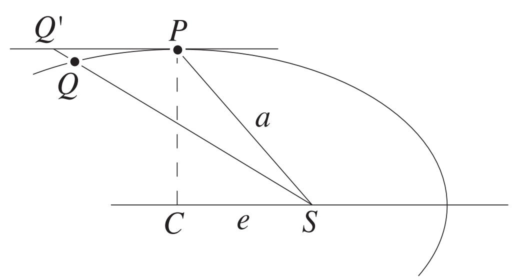
Quiz **Name**

1a. In the diagram below, the points A, B, C, and D lie on a straight line and the distance between A and B is equal to the distance between C and D. Use the diagram to explain why the areas of the triangles ΔABS and ΔCDS are equal.



1b. Suppose that a point mass P of mass m moves along a straight line with constant speed. Let S be any point not on the line. Show that the segment PS sweeps out equal areas in equal times.

2. The figure below considers a planet in position P at the "top" of its elliptical orbit and again at a time Δt later at Q. The point C is the center of the ellipse. For a small Δt, PQ is approximately equal to PQ' and the area of the elliptical sector SPQ is approximately equal to the area of the triangle SPQ'.



a) Let $\Delta s = Q'P$. Determine an expression involving Kepler's constant κ and the semiminor axis of the ellipse that approximates the average speed $\frac{\Delta s}{\Delta t}$ of the planet from P to Q.

b) Use the fact that $\kappa = \frac{ab\pi}{T}$ and push Δt to zero to show that the speed of the planet at P is equal to $v_P = \frac{2\pi a}{T}$.

Formulas and Data: $A = ab\pi$, $a^2 = b^2 + c^2$, $\varepsilon = \frac{c}{a}$, $F = ma$, $\kappa = \frac{A_t}{t}$, $M = \frac{4\pi^2 a^3}{GT^2}$, $G = 6.673 \times 10^{-11}$ in M.K.S., $F = G\frac{mM}{r^2}$, $F = \frac{4\pi^2 a^3 m}{T^2}\frac{1}{r_P^2}$, $\frac{a^3}{T^2} = \frac{GM}{4\pi^2}$,