

CALCULUS
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0520-1. A triangle is growing. At time t , its sides have lengths $4x$, $6x$ and $8x$, and its area is A , so x and A depend on t . Find a formula for dA/dt in terms x and dx/dt . (Hint: Heron's formula says: $A = \sqrt{s(s - 4x)(s - 6x)(s - 8x)}$, where $s := (4x + 6x + 8x)/2$.)

0520-2. A regular octagon is growing. At time t , its area is A and its side length is s , so A and s are expressions of t . Find a formula for dA/dt in terms of s and ds/dt .

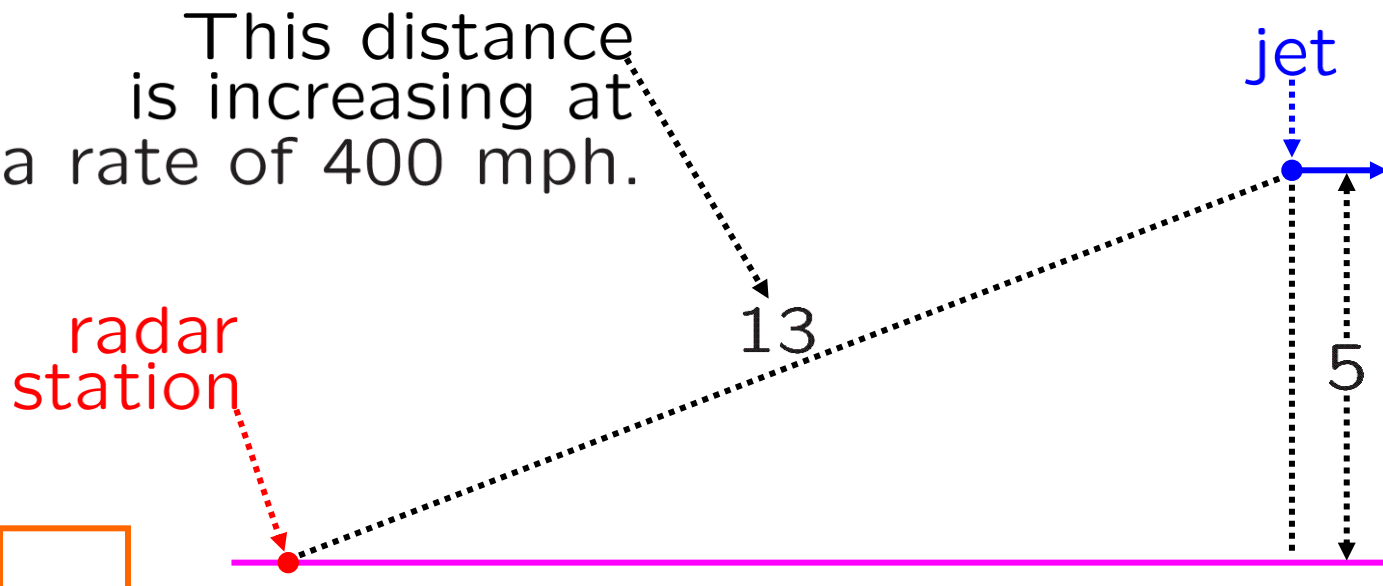
0520-3. A square-based pyramid is growing. At time t , its height is h and its base side length is s and its volume is V , so h , s and V are expressions of t . Assume, for all t , that $h = s/2$. Find a formula for dV/dt in terms of s and ds/dt . (Hint: $V = s^2h/3$.)

0520-4. Suppose $x^4 + 2y^6 + 27 = z + 4z^3$ and $dx/dt = 4$ and $dy/dt = 7$. Compute dz/dt at a certain moment when

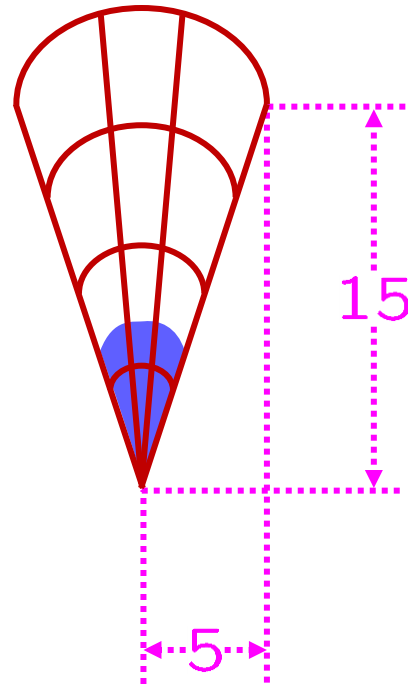
$$x = 4, y = 3 \text{ and } z = 2.$$

0520-5. A streetlight is at the top of a 20 foot pole. A 6 foot tall man walks directly away from the light at a speed of 5 feet per second. How fast is his shadow growing?

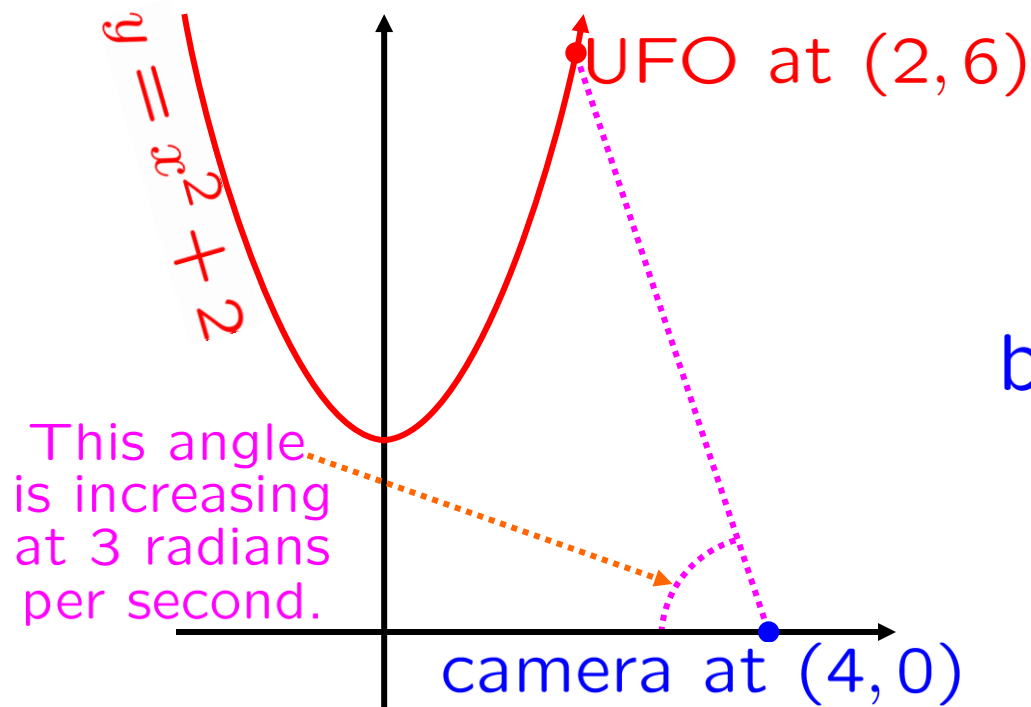
0520-6. A jet flies in a straight line, with constant speed and altitude. It flies directly over a radar station, and, a few minutes later, the radar's instruments show that the plane is 13 miles away, and that its distance from the radar station is increasing at 400 mph. Assuming that the altitude of the jet is 5 miles greater than that of the station, find the speed of the jet.



0520-7. Water is being drained, at a rate of 3 cubic meters per minute, from a conical container of height 15 meters, whose top is a circle whose radius is 5 meters. When the water level is 5 meters, how fast is that level decreasing?



0520-8. A camera at $(4, 0)$ is following a UFO that strafes in from above, following the curve $y = x^2 + 2$ from left to right. At the moment when the UFO is at the point $(2, 6)$, retreating back into outer space, the angle between the camera and the horizontal is increasing at 3 radians per second.



- What is the rate of change in the x -coordinate of the the UFO at that moment?
- What is the rate of change in the y -coordinate of the the UFO at that moment?

0520-9. Sand is being poured, at a rate of 5 cubic meters per minute, into a conical pile that is always twice as wide as it is high.

How fast is the height of the pile increasing when the pile 12 meters wide and 6 meters high?

WARNING: We're asking about (rate of change in) HEIGHT, not width.

SAND



5 cubic meters per minute

