

CALCULUS  
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OLD2

0520-1. An isosceles right triangle is growing.

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At time  $t$ , its area is  $A$  and its leg length is  $s$ , so  $A$  and  $s$  are expressions of  $t$ . The triangle's hypotenuse length is  $s\sqrt{2}$ . Find a formula for  $dA/dt$  in terms of  $s$  and  $ds/dt$ .

0520-2. A regular pentagon is growing. At

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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  $J_1$  (**Johnson<sub>1</sub>**) solid is a pyramid

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whose base is a square and whose sides are equilateral triangles. A  $J_1$  solid is growing. At time  $t$ , its volume is  $V$  and its edge length is  $s$ , so  $V$  and  $s$  are expressions of  $t$ . Find a formula for  $dV/dt$  in terms of  $s$  and  $ds/dt$ .

( Hint:  $V = (\sqrt{2}/6)s^3$ . )

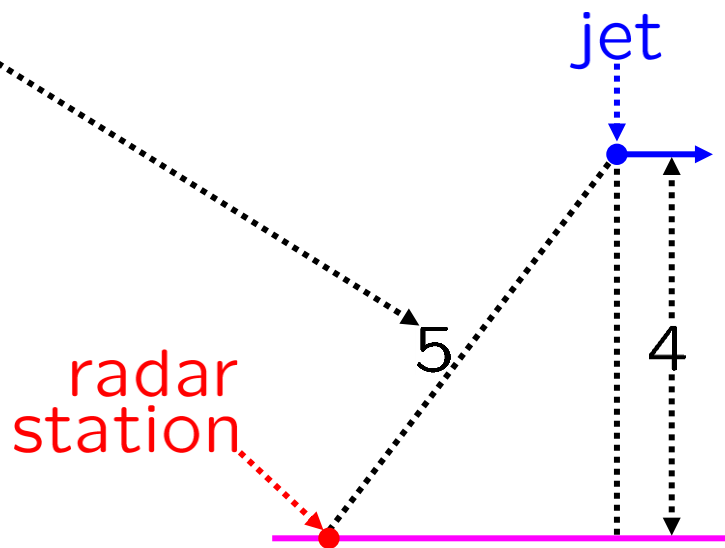
0520-4. Suppose  $x^3 + y^3 + 27 = z^2 + z^3$  and  
OLD2  $dx/dt = 6$  and  $dy/dt = 8$ . Compute  $dz/dt$   
at a certain moment when

$$x = 1, y = 2 \text{ and } z = 3.$$

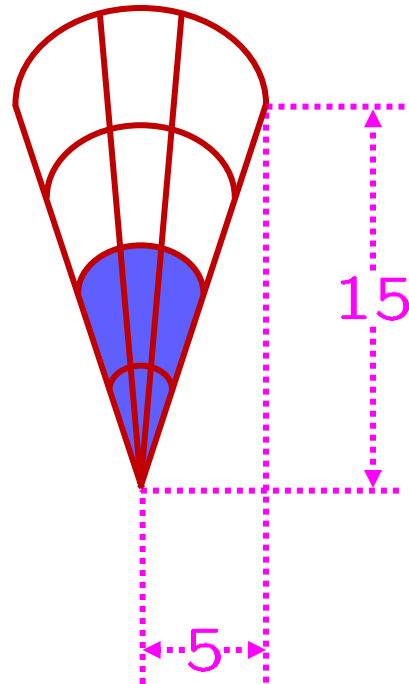
0520-5. A streetlight is at the top of a 24 foot  
OLD2 pole. A 6 foot tall man walks directly away  
from the light at a speed of 4 feet per second.  
How fast is his shadow growing?

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 5 miles away, and that its distance from the radar station is increasing at 390 mph. Assuming that the altitude of the jet is 4 miles greater than that of the station, find the speed of the jet.

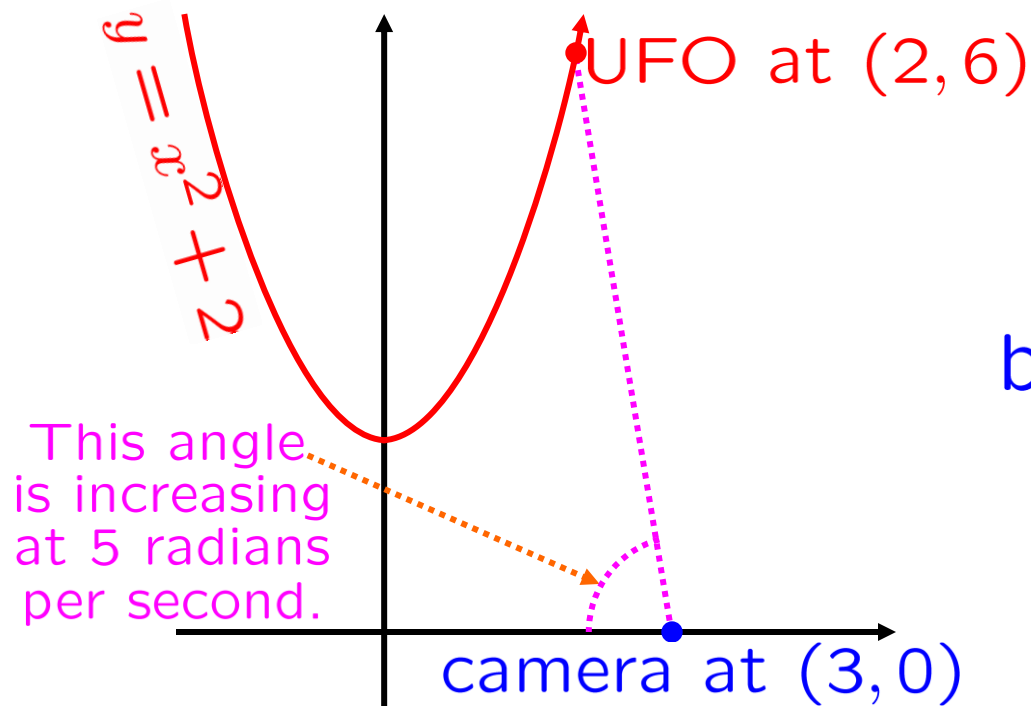
This distance is increasing at a rate of 390 mph.



0520-7. Water is being drained, at a rate of 4 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 7.5 meters, how fast is that level decreasing?



0520-8. A camera at  $(3, 0)$  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 5 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 6 cubic meters per minute, into a conical pile that is always  $\frac{5}{8}$  as high as it is wide. How fast is the width of the pile increasing when the pile 8 meters wide and 5 meters high?

