

5. A balloon is rising at a constant speed of 5 ft/s. A boy is cycling along a straight road at a speed of 15 ft/s. When he passes under the balloon, it is 45 ft above him. How fast is the distance between the boy and the balloon increasing 3 s later?

$$h_t = 5 \quad \text{goal: } z_t$$

$$x_t = 15$$

h 3 seconds later:

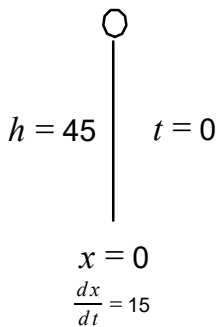
$$h_3 = 45 + 5(3) = 60 \text{ ft}$$

x three seconds later:

$$x_3 = x_t \cdot 3 = 15(3) = 45$$

find z 3 seconds later also:

$$z_3 = \sqrt{60^2 + 45^2} = 75$$



it's a triangle, so relate the sides with the Pythagorean Theorem

$$z^2 = x^2 + h^2$$

differentiate with implicit differentiation

$$2zz_t = 2xx_t + 2hh_t$$

divide 2 away:

$$zz_t = xx_t + hh_t$$

solve for z_t by dividing both sides by z

$$z_t = \frac{x_3 x_t + h_3 \cdot h_t}{z}$$

$$\frac{dz}{dt} = \frac{45(15) + 60(5)}{75} = (45(15) + 60(5))/75 = 13 \text{ ft/s}$$

