Assume all variables are functions of time.

1 Pythagorean Relations

Problem 1. *Suppose $x = x(t)$, $y = y(t)$, and $z = z(t)$ are related by the Pythagorean Theorem. So,*

$$x^2 + y^2 = z^2$$

How are $\frac{dx}{dt}$, $\frac{dy}{dt}$, and $\frac{dz}{dt}$ related? In particular, what happens when $\frac{dz}{dt} = 0$?

Problem 2. *A ladder $10m$ long rests against a vertical wall. If the bottom of the ladder slides away from the wall at a rate of 1 m/s, how fast is the top of the ladder sliding down the wall when the bottom of the ladder is $6m$ from the wall?*

Problem 3. *Two cars leave from the same point at the same time. Car A is traveling east at* $50km/h$ *and car B is traveling north at* $60km/h$*. At what rate is the distance between the two cars changing when car A is* $0.3km$ *and car B is* $0.4km$ *from their starting point?*

Problem 4. *A plane flying horizontally at an altitude of* 1 *km and a speed of* $500km/h$ *passes directly over a radar station. Find the rate at which the distance from the plane to the station is increasing when it is* $2km$ *away from the station.*

Problem 5. *A Little League baseball diamond is a square with* $60ft$ *on each side. A player runs from 1st base to 2nd base at* $12ft/s$*. At what rate is the player's distance from home plate increasing if he is halfway between 1st and 2nd base?*

Problem 6. *A boat is pulled into a dock by a rope attached to the bow of the boat and passing through a pulley on the dock that is* $1m$ *higher than the bow of the boat. If the rope is pulled in at a rate of* $1m/s$*, how fast is the boat approaching the dock when it is* $8m$ *from the dock?*

2 Trigonometric Relations

Problem 7. *A man walks along a straight path at a speed of* 4 *ft/s. A searchlight is located on the ground* 20 *ft from the path and is kept focused on the man. At what rate is the searchlight rotating when the man is* 15*ft from the point on the path closest to the searchlight?*

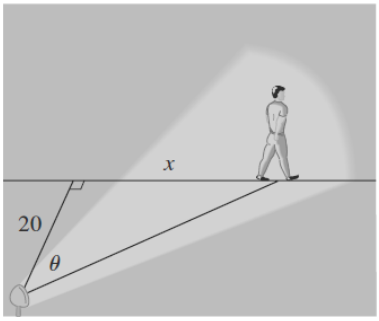

Figure 1: §3.10, Fig. 5, Stewart Calculus 5th Edition

Problem 8. *Two sides of a triangle are* 4*m and* 5*m in length and the angle between them is increasing at a rate of* 0.06*rad/s. Find the rate at which the area of the triangle is increasing when the angle between the sides of fixed length is* $\frac{\pi}{3}$.