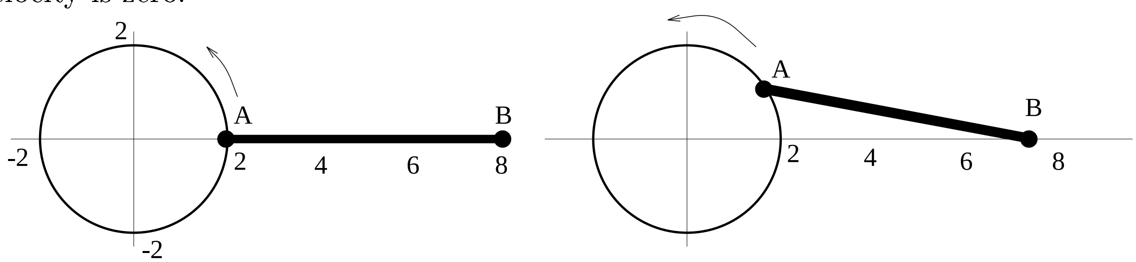
HOMEWORK (WINTER/SPRING) -WEEK 7

1. Stewart, section 3.9: #11, 13, 23, 27, 35, 38, 44.
2. A six foot long rod is attached at one end A to a point on a wheel of radius 2 feet, centered at the origin. The other end B is free to move back and forth along the x-axis. The point A is at $(2, 0)$ at time $t = 0$, and the wheel rotates counterclockwise at constant speed with an angular speed of 3 revolutions per minute. Find the acceleration of B when its velocity is zero.

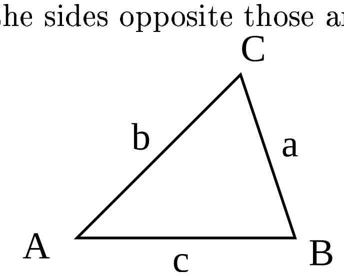


time t=0

time t > 0

3. Stewart, section 3.10: #1,3,27,32a,44.

4. In the triangle pictured, let A, B, C be the angles at the three vertices, and let a, b, c be the sides opposite those angles.



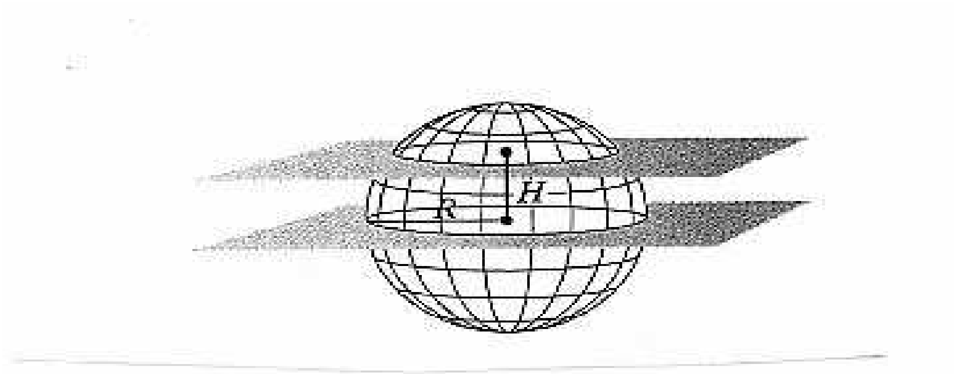
According to the "law of sines," you always have:

$$\frac{b}{a} = \frac{\sin B}{\sin A}.$$

Suppose that a and b are pieces of metal which are hinged at C. At first the angle A is 45° and the angle B is 60°. You then widen A to 46°, without changing the sides a and b. What happens to the angle B? Use the tangent line approximation.
5. Roadway Plastics manufactures plastic dome-shaped road bumps (used for lane separation) of radius 2 inches. These bumps are in the shape of a cap of a sphere (a slice taken off the top of a sphere). The volume of a road bump of radius 2 inches and height h inches can be calculated: the volume is $\frac{\pi}{2}(\frac{1}{3}h^3 + 4h)$ cubic inches. The wear-resistant plastic used costs $\frac{30}{\pi}$ cents per cubic inch. Currently the bumps are 1 inch high, so they cost 65

cents each. The Department of Safety wants to order new bumps that are higher, and they are willing to pay 68 cents each. Approximately how high will the new higher road bumps be? Use the tangent line approximation.

6. A sphere of radius 3 inches is sliced with two parallel planes: one passes through the equator and the other is H inches above the first plane. The resulting portion of the sphere between the two planes is called a *spherical segment*; see the picture:

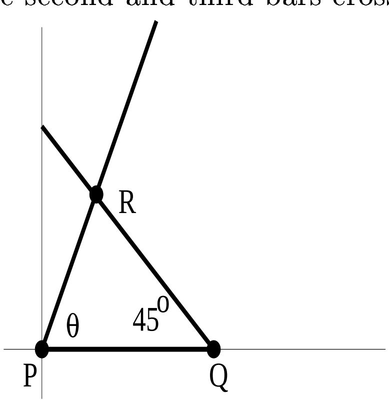


In Math 125, you will show that the volume V of the spherical segment is given by this formula (which we will assume):

$$V = \frac{\pi}{3} H(27 - H^2).$$

(a) Find the volume of the spherical segment if $H = 1$.
(b) Find the rate of change of the volume with respect to H of the spherical segment at $H = 1$.
(c) Use the tangent line approximation at $H = 1$ to estimate the value of H that will yield a spherical segment having volume 25 in^3.

7. A metal rod 1 meter in length is placed horizontally on the x-axis, with its ends located at the points $P = (0, 0)$ and $Q = (1, 0)$. A second long metal rod is attached to the first one at the point $Q = (1, 0)$ and makes an angle of 45° with the first. A third long metal rod is attached to the first rod at the point $P = (0, 0)$ and is free to rotate about P. Thus, the angle θ made by the first and third bars is free to change. For θ between 0° and 90° the second and third bars cross at a point $R = (x, y)$ (see figure).



(a) Find a relationship between x, y and θ; then eliminate y by expressing y in terms of x. This gives you a relationship between x and θ.

(b) Notice that $x = 0.5$ meter when $\theta = 45°$. By approximately how much should you increase θ if you want the x coordinate of the point R to decrease to $x = 0.45$ meters? Use the tangent line approximation.

8. Stewart, section 4.1: #5,29,39,41,43,47,51,55,57,70.

9. Stewart, section 4.7: # 46. (This is not a typo, you should be able to do this problem using the tools of section 4.1.)