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Worksheet week 7

Calculus I

Fall 2013

1. (a) Find, with proof, the formula for  $(\arctan x)'$ .

(b) A boat sails directly toward a 200-meters skyscraper that stands on the edge of the harbor. The “angular size”  $\theta$  of the building is defined by the angle (in radians) formed by the lines from the top and the bottom of the building to the observer in the boat (picture will be drawn in class). What is the rate of change of the angular size with respect to the horizontal distance  $d\theta/dx$  when the boat is  $x = 800$  m from the building? Give your answer both in radians per meter and in degrees per meter. Interpret the answer in practical terms and explain also the sign of your result.

2. A plane traveling horizontally at 80 m/s over flat ground at an elevation of 3000 m releases an emergency packet. The trajectory of the packet is given by

$$x = 80t, \quad y = -4.9t^2 + 3000, \quad \text{for } t \geq 0,$$

where the origin is the point on the ground directly beneath the plane at the moment of the release, and  $t$  is the time in seconds since the moment of release.

(a) Graph the trajectory of the packet and find the coordinates of the point where the packet lands.

(b) Find  $dx/dt$ ,  $dy/dt$ , explain their practical meaning and why the formulas you got for each of them makes sense.

(c) Find the angle at which the released package hits the ground.