

Exam 1
Math 125, Section 8, Fall 2005
September 14, 2005

For full credit, show all your work/sketch any graphs that you produce on your calculators.

Problem 1 20 points

Air pressure decays exponentially as a function of height above sea-level at a *continuous rate* of 12% per kilometer.

(a) Write a formula for the air pressure as a function of h , the height above sea-level in kilometers.

(b) What is the air pressure at the top of Mt. McKinley, height of 6198 meters as a percentage of the sea-level air pressure. (Note: 1 Kilometer = 1000 meters)

(c) What is the *halving-height* for the air pressure, that is what is the height at which the air pressure is half its sea level value?

Problem 2

20 points

Galileo discovered that the period of a swinging pendulum is **proportional** to the square-root of the length of the pendulum. When the pendulum is two feet long, the period is 1.57 seconds.

(a) Find the equation for the period of a pendulum, P , in terms of its length, l .

(b) Foucault demonstrated rotation of the earth by hanging a pendulum from the roof of a building in Paris named Pantheon. The pendulum takes 16.5 seconds for an oscillation. Find the height of Pantheon, assuming the pendulum at rest is one foot above the ground of the building.

Problem 3

40 points.

(a) Solve the equation $P_0a^t = Q_0b^t$ for t assuming P_0, Q_0, a, b are positive constants.

(b) A particle moves on a circle of radius 5 and the angle θ between the position of the particle and the x -axis is given by

$$\theta = \begin{cases} \pi - t & \text{for } 0 \leq t < \pi/2 \\ \frac{2}{\pi}t^2 & \text{for } \pi/2 < t \leq 2\pi \end{cases}$$

Graph the x -coordinate as a function of time.

(c) Let $f(x) = \frac{\sin(\pi x)}{x - 2}$. Using a table of values estimate $L = \lim_{x \rightarrow 2} f(x)$, and find a value δ such that $|x - 2| < \delta$ guarantees that $|f(x) - L| < 0.001$.

(d) Find the limit

$$\lim_{x \rightarrow \infty} \frac{ax^3 - 4x^2 + 2}{1 + 8x^k}$$

or state that the limit does not exist. (Hint: The answer depends on a and k , and you have to do separate cases)

Problem 4 Find possible formulas for the graphs in the following figure.
20 points.

