Name ______________________ Section ________

# Math 120E (Midterm)

!!!!! READ READ READ !!!

**Instructions:**

- **Show your work; no credit for answers only.**
- **Write your name on the exam.**
- **If you are using a graphing calculator, "zooming in" to find a value on a function graph, using solvers, and so on, will not be sufficient justification for any answer on this exam. You are free to use the calculator to check yourself. When in doubt, ask a question by raising your hand. I will come around to help as soon as possible.**

**SCORE (40 possible):**

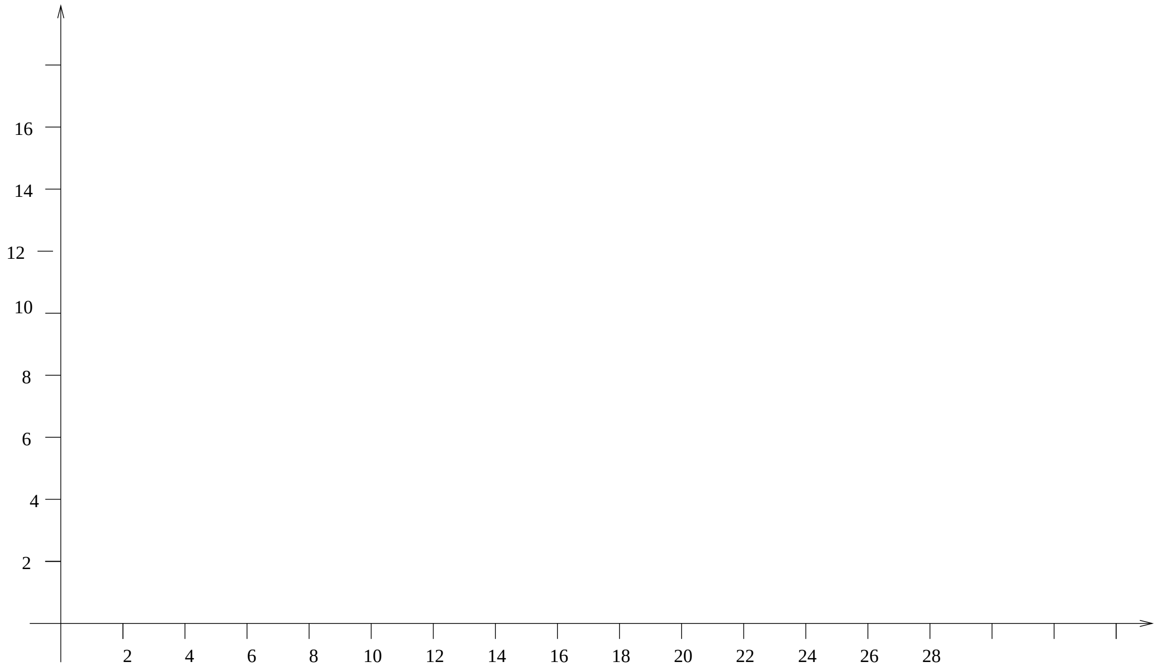
Problem #1 (20) ______________

Problem #2 (20) ______________

TOTAL ______________

**Problem 1 (20 points):** You are vacationing at Canada's Bay of Fundy, where the difference between high and low tides is 15 meters, the greatest difference anywhere in the world. There are 12.5 hours between successive high tides. At 2 a.m. on November 6, the tide is at high tide. Let $t = 0$ be two hours earlier, at midnight.

(a) (6 points) Let $h(t)$ be the height of the tide above low tide, in meters, at time $t$ hours after midnight. So, for example, $h(2) = 15$. Assume that the height of the tide above low tide varies sinusoidally with time. Sketch the graph of $h(t)$ for two cycles on the axis system provided below. Clearly label the maximum and minimum points with their coordinates.




(b) (6 points) Give a formula for $h(t)$ which involves no unknown constants.

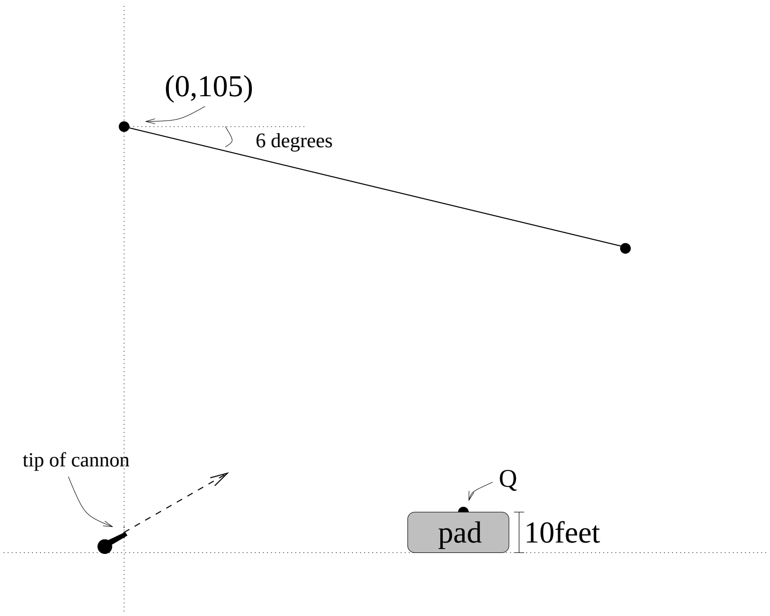
(c) (4 points) You spend the morning reading **Joy of Math** at your favorite spot on the beach. However, at 12:45 p.m. (45 minutes after noon), the tide reaches your spot and you have to move to avoid getting wet. At what time that afternoon will you be able to return to your favorite spot and still stay dry?

(d) (4 points) During the first 40 hours after midnight on November 6th, how many hours will the tide level reach or exceed the level of your favorite spot on the beach?

**Problem 2 (20 points):** Terry the Human Cannonball is going to be launched from a cannon. She is inside a large building with a sloped ceiling. The ceiling is 105 feet high directly above her cannon, and it slopes downward at an angle of 6°. Terry will land on a large pad that is 10 feet off the ground.

Impose coordinates with the origin directly under the cannon, as in the picture below. In this coordinate system, Terry's path in the air is given by the equation

$$y(x) = -.003x^2 + .6x + 5$$




(a) (2 points) How high is the tip of the cannon off the ground?

(b) (4 points) The point $Q$ is in the center of the pad, 10 feet off the ground, as in the picture. Terry will land at this point $Q$. Find the coordinates of this point. (This will tell Terry where to place the pad.)

(c) (5 points) Terry's horizontal speed is a constant 73 ft/s. That is, her $x$-coordinate at time $t$ is given by $x(t) = 73t$. **When** is Terry at her highest height above the ground?

(d) (5 points) The ceiling can be described as part of a graph of a line. Find the equation of this line.

(e) (4 points) What is the smallest vertical distance between Terry and the ceiling?