You are allowed to use a scientific calculator with no graphing capabilities and one 8.5×11 sheet of notes.

• Complete all questions.
• Show all your work.
• You have 50 minutes to complete the exam.

GOOD LUCK!
1. (10 points) Find the domain, the zero(s), the \( y \)-intercept, the horizontal asymptote, and the vertical asymptote(s) of the following rational function:

\[
f(x) = \frac{4(x - 5)(x - 1)}{3(x - 3)(x + 1)}
\]

domain:

zero(s):

\( y \)-intercept:

horizontal asymptote:

vertical asymptote(s):
2. (8 points) The following is the graph of the function \( y = f(x) = (x - 3)^2 + 5 \) on the domain \( 3 \leq x \leq 7 \).

(a) What is the range of \( y = f(x) \)?

(b) Find a formula for \( f^{-1}(x) \).

(c) Sketch a graph of \( f^{-1}(x) \), clearly indicating the domain and range.
3. (10 points)

(a) The angles in the following picture have measures $170^\circ$ and 2.8 radians. Determine which angle has which measure. Justify your answer.

(b) Which of the following functions has the larger period? Justify your answer.
4. (10 points) The height of Elastic Man can be represented by a sinusoidal function of time. His maximum height is 7.4 feet. His minimum height is 3.4 feet. At 8 AM today, he was 5.4 feet tall and he was getting taller. He will not be 5.4 feet tall again until noon tomorrow.

(a) Write a sinusoidal function that represents Elastic Man’s height as a function of time $t$ in hours since midnight last night. Write your function in standard form.

(b) Describe two points in time when Elastic Man is exactly 7 feet tall.
5. (12 points) Two dogs are moving around a circular track. Tiny Jim runs \textbf{counterclockwise} around the outside lane, which is a circle of radius 150 feet, with a linear speed of 15 feet per second. Ollie runs \textbf{clockwise} around the inside lane, which is a circle of radius 120 feet, with an angular speed of 0.16 radians per second. Given is a picture, viewed from above, of the track and the starting position of the dogs on an imposed coordinate system.

(a) What is Tiny Jim’s angular speed in radians per second?

(b) Where is Tiny Jim located after 30 seconds? (Give TJ’s $x$- and $y$-coordinates.)

(c) Where is Ollie located after 20 seconds? (Give Ollie’s $x$- and $y$-coordinates.)

(d) Find the first time when Ollie and Tiny Jim pass each other. (HINT: They will pass each other when the angle between them is 0.)