

NAME: _____

Student ID #: _____

Signature: _____

QUIZ SECTION: _____

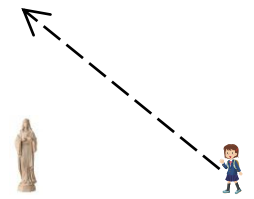
Math 120 Final Exam Spring 2012

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- You may use a non-graphing calculator and one double-sided handwritten sheet of notes. Please put away everything else right now, and TURN OFF your cell phone.
- Your exam should contain 8 problems on 8 pages. When the test starts, check that you have a complete exam!
- Unless otherwise stated, you **must show how you get your answers**. Correct (or incorrect) answers with no supporting work will result in little or no credit. If you use a trial-and-error method when an algebraic method is available, you will not receive full credit.
- Please box your **final answer**.
- You may either round off your final answer to 2 decimal digits, or leave it in exact form (for instance, $\sqrt{2}\pi + 5$, or 7.51). Do not round any intermediate values or bases of exponential functions.
- If you need more room, use the backs of pages and indicate to the grader that you have done so.
- Raise your hand if you have a question. You have 2 hours and 50 minutes to complete the exam.

GOOD LUCK!

Problem 1 (16 pts) Linda is walking in a straight line from a point 40 feet due east of a statue, to a point 30 feet due north of the statue. She walks at a constant speed of 2 feet per second.



a) Impose a coordinate system with the origin at the statue and determine the parametric equations giving the x and y -coordinates for Linda's position at time t seconds.

b) Find all the times when Linda is at a distance of 25 feet from the statue.

c) Find Linda's position (x, y) when she is closest to the statue.

Problem 2 (10 pts) Solve the following two equations. Show all steps, and box your final answers.

a) $7x + |2x - 5| = 4$

b) $\ln\left(\frac{2x}{x-5}\right) = 3$

Problem 3 (12 points)

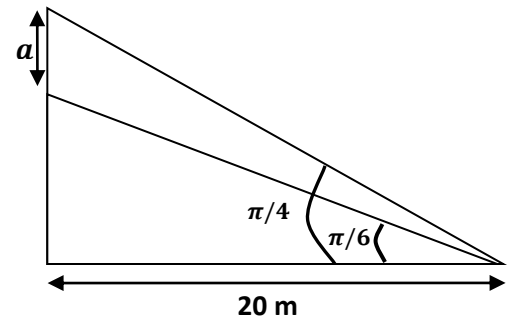
The population of Arcadia increases by 8% every 10 years. The population of Brom triples every 120 years. The two cities had equal populations of 10,000 residents each in the year 2000.

In what year will the city of Brom have twice as many residents as the city of Arcadia?

Problem 4 (12 pts)

- a) (5 pts) Consider the function $f(x) = 2 + \sqrt{9 - x^2}$, restricted to domain $-3 \leq x \leq 0$. Find the rule for the inverse function, $f^{-1}(x)$.

- b) (7 pts) Compute the length labeled “ a ” on the following picture (all given angles are in radians, so make sure your calculator is in radian mode.)

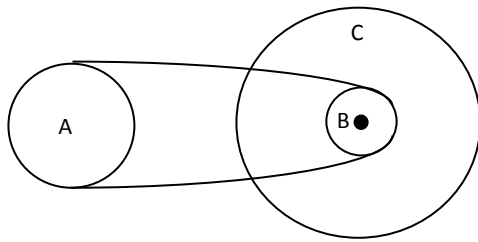


Problem 5 (8 pts)

You are designing a system of wheels and belts as pictured. Wheels B and C are rigidly fastened to the same axle, while wheels A and B are connected by a belt.

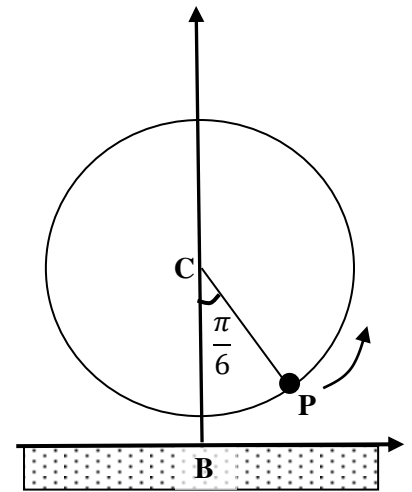
You want wheel A to rotate at 2 rad/sec, and wheel C to have a linear velocity of 6 miles per hour. Wheel A has radius $R_A = 6$ in, and wheel C has radius $R_C = 15$ in.

What should be the radius of wheel B?



Problem 6. (16 pts) Percy is riding on a ferris wheel of radius 50 feet, whose center C is 52 feet above ground. The wheel rotates at a constant rate in the direction shown by the arrow, taking 1.5 minutes for each full revolution. The wheel starts turning when Percy is at the point P , making an angle of $\frac{\pi}{6}$ radians with the vertical, as shown. (*Make sure your calculator is in radian mode*)

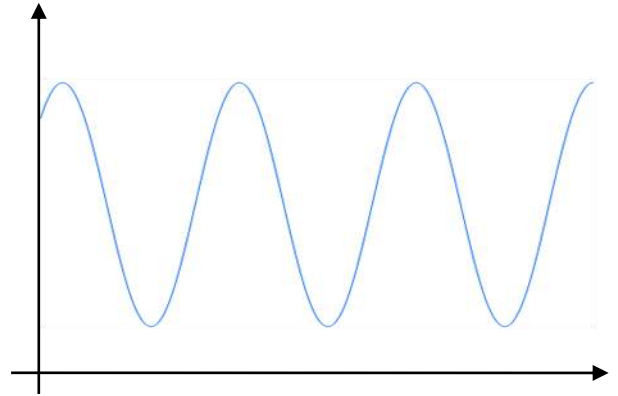
a) (5 pts) How high is Percy above ground when the wheel starts turning?



b) (4 pts) Impose a coordinate system **with the origin at the base point B**. What is the equation of the line CP ?

c) (7 pts) Percy drops his ice cream cone 1.25 minutes after the wheel starts moving. If the cone falls straight down from Percy's position at that time, where does it land with respect to the base point B ?

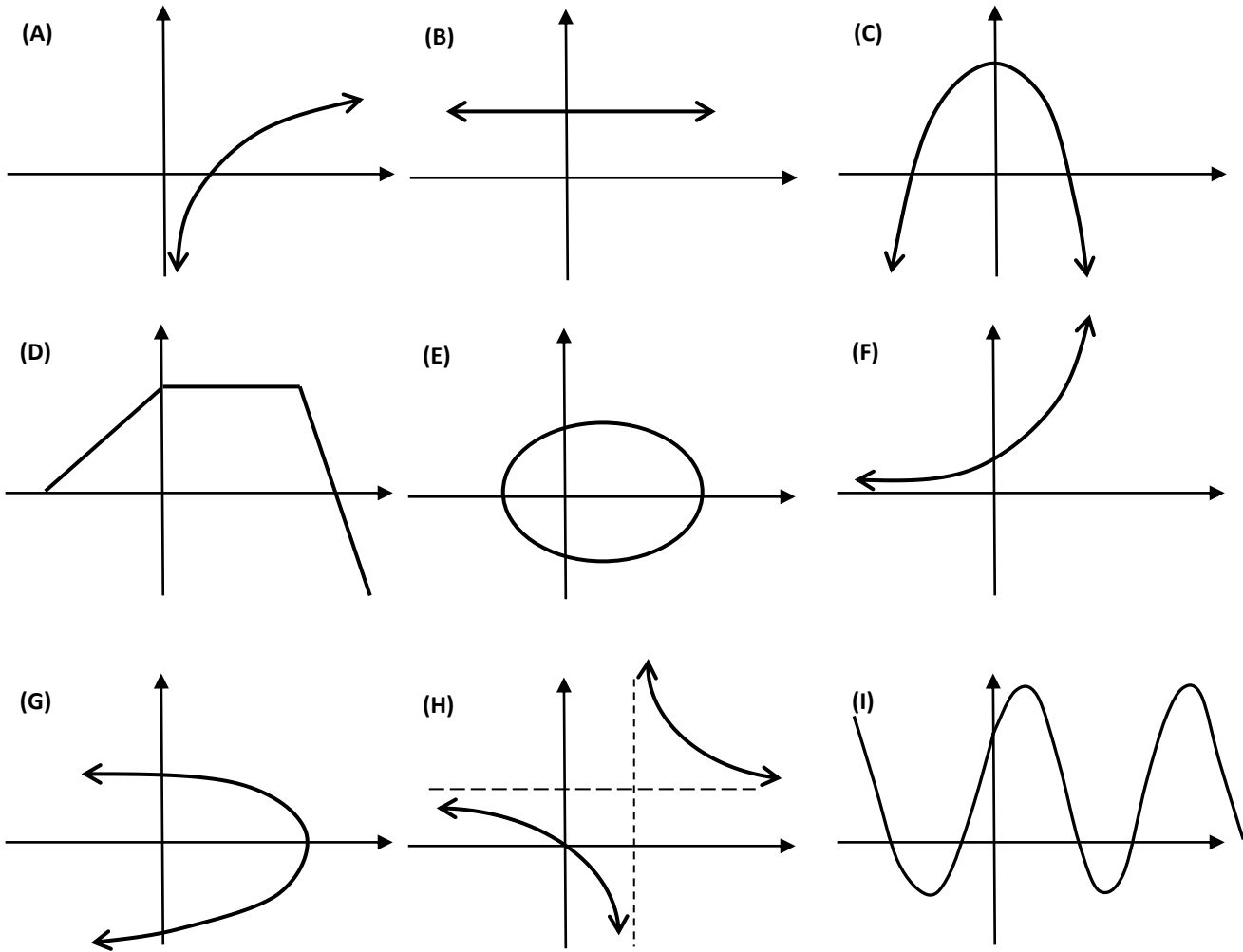
Problem 7 (16 pts) The **depth** of a swimming salmon below the water surface can be modeled by a sinusoidal function of time. The salmon's depth varies between a minimum of 1 foot and a maximum of 7 feet below the surface of the water. It takes the salmon 1.8 minutes to move from its minimum depth to its successive maximum depth, and it first reaches the minimum depth at $t = 2$ minutes.



a) Find the sinusoidal function $d(t) = A \sin\left(\frac{2\pi}{B}(t - C)\right) + D$ which models the depth of the salmon after t minutes.

b) Compute all the times during the first 5 minutes when the depth of the fish is exactly 3 feet.

Problem 8 (10 points) Consider the following nine graphs, labeled (A)-(I).



Answer the following questions -- no need to justify or show any work.

- a) Which of these graphs above do **not** represent graphs of functions? _____
- b) From those that are functions, which ones **are one-to-one** (invertible)? _____
- c) Which of the graphs shown above (if any) could be the graph of a function $y = f(x)$ of the following types:
- i. Quadratic? _____
 - ii. Exponential? _____
 - iii. Logarithmic? _____
 - iv. Rational (linear-to-linear)? _____
 - v. Multi-part? _____
 - vi. Trigonometric? _____