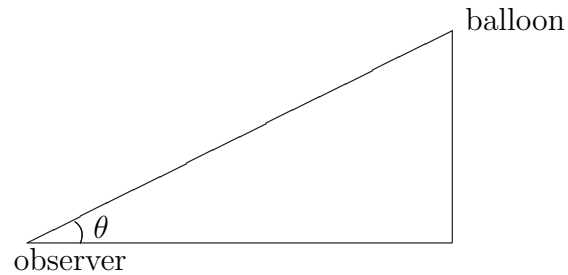


Part B: Calculators may be used.

Answer each question completely. Show all work. No credit is allowed for mere answers with no work shown. Show the steps of calculations. State the reasons that justify conclusions.

11. (10 points) A balloon leaving the ground 1200 ft from an observer rises at the rate of 200 ft/min. How fast is the angle θ of elevation of the observer's line of sight increasing when the balloon is at an altitude of 1600 ft? Be sure to include the units in your answer.



12. (10 points) A bacterial population grows at a rate proportional to its size, so the population size y satisfies $dy/dt = ky$ for a suitable constant k . Initially, there are 4,000 bacteria, but 2 hours later, the population has increased to 5,000 bacteria. How many hours after the initial time will the population reach double its initial size? Give an exact answer.

13. (10 points) Consider the function $f(x) = x^4 - 4x^2 + 3$.

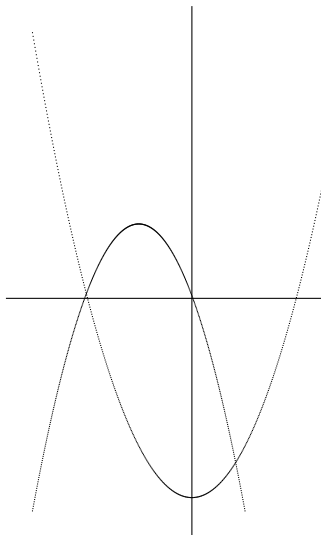
(a) Tell the interval or intervals where $f(x)$ is increasing and where $f(x)$ is decreasing. Give exact answers.

(b) Tell the interval or intervals where $f(x)$ is concave up. Give exact answers.

(c) Tell all the critical points. For each critical point tell whether it is a local maximum, a local minimum, or neither. Justify your answers.

14. (10 points) Mary has 96 feet of fence that she would like to use to enclose a rectangular garden. One side of the garden will be along the side of her house. The side along the house needs no fence. What are the length and width of the garden that has maximum area?

15. (10 points) Consider the total area between the curves $y = x^2 - 4$ and $y = -x^2 - 2x$ to the right of $x = -3$ and to the left of $x = 1$. See the figure.



- (a) Set up explicit definite integrals for the area.
- (b) Evaluate the integrals in part (a). Simplify your answer. (There will be NO CREDIT if the work is not shown.)