Instructions

During this session, **calculator** is permitted.

- Each team has 30 minutes to answer three questions.
- There are three questions in this section, each worth 9 points.
- Write your answers neatly and clearly and label all problems and parts.
- Each team submits **only one** set of answers at the end of the thirty minutes. You must cross out whatever you do not wish to be considered.
- You must show steps and reasoning. Partial credit may be given. All answers in this section should be in exact form, like $\ln 2$, unless otherwise indicated.
- Include units where appropriate.
- Make sure the names of all members are written clearly.

School: _____

Team Members: _____

Score: /27

1.) The concentration C (in milligrams) of a certain drug in a patient's bloodstream t minutes after injection is given by

$$C(t) = \frac{50t}{t^2 + 25}$$

Graph $C(t)$ to answer the following questions.

a. **(1 pt)** What happens to the concentration of the drug as t increases?

b. **(2 pts)** Determine the time at which the concentration is highest.

c. **(1 pt)** What is the highest concentration?

d. **(2 pts)** What is the horizontal asymptote of $C(t)$? What does it mean in this situation?

e. **(3 pts)** If the drug is to be re-administered when the concentration decreases to 2 milligrams, how many minutes after the initial dose is the drug re-administered?

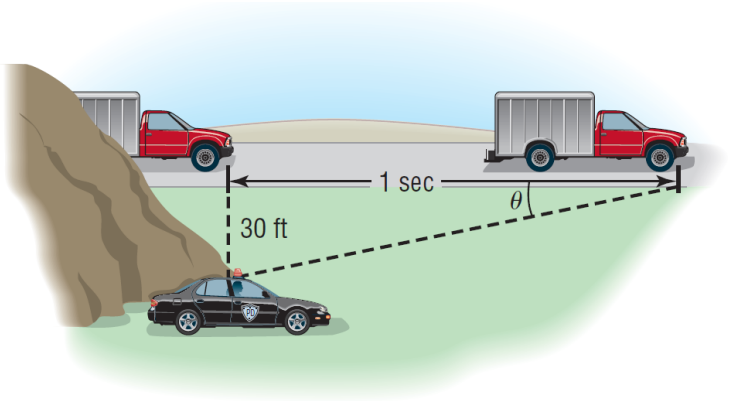
2.) A scientist wanted to test the effect of a new fertilizer. After applying it to two separate plants, he found that Plant A grew at a rate of 1 cm per day while Plant B grew at a rate of 5% per day. Plant A started at a height of 5 cm while Plant B started at a height of 2 cm.

(a) **(3 pts)** Give equations for the height (h_A and h_B) of each plant with respect to time t.

(b) **(3 pts)** Give the height of each plant after 50 days. Give your answers to 3 decimal places.

(c) **(3 pts)** When will the height of each plant be equal? What height are the plants at this time? Give your answers to 3 decimal places. Be sure to justify your answers.

3.) A state trooper is hidden 30 feet from a highway. One second after a truck passes, the angle θ between the highway and the line of observation from the patrol car to the truck is measured.



(a) **(3 pts)** If the angle measures 15°, how fast is the truck traveling? Express the answer in feet per second and in miles per hour.

(b) **(3 pts)** If the angle measures 20°, how fast is the truck traveling? Express the answer in feet per second and in miles per hour.

(c) **(3 pts)** If the speed limit is 55 miles per hour and a speeding ticket is issued for speeds of 5 miles per hour or more over the limit, for what angles should the trooper issue a ticket?