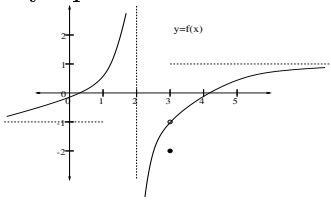


1 (18 points) Estimate the following values from the graph below. The dashed lines are asymptotes.



(a) (3 points) $f(3)$

Answer: -2

(b) (3 points) $\lim_{x \rightarrow 3} f(x)$

Answer: -1

(c) (3 points) $\lim_{x \rightarrow 3} (3[f(x)]^2 - 7)$

Answer: -4

(d) (3 points) $f(f(5))$

Answer: .1

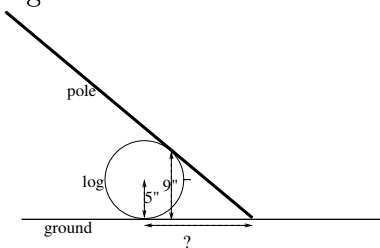
(e) (3 points) $\lim_{x \rightarrow 2^+} f(f(x))$

Answer: -1

(f) (3 points) $\lim_{h \rightarrow 0} \frac{f(1+h) - f(1)}{h}$

Answer: 1

2 (15 points) A straight fishing pole leans against a round log as in the figure below. The log has a radius of 5 inches and the point where they touch is 9 inches above the ground.



(a) (7 points) Find the slope of the fishing pole.

Answer: $-\frac{3}{4}$

(b) (8 points) Find the distance along the ground from the bottom of the log to where the pole touches the ground.

Answer: 15 inches

3 (22 points) Compute the following limits:

(a) (5 points) $\lim_{x \rightarrow 0^+} \frac{\cos x^2}{x^3 + 2}$

Answer: $\frac{1}{2}$

(b) (7 points) $\lim_{h \rightarrow 0} \frac{(5+h)^2 - 5^2}{h}$

Answer: 10

(This limit is the slope of the tangent line to a curve at a point. What are the curve and the point?)

Answer: $y = x^2$ at the point (5, 25)

(c) (5 points) $\lim_{x \rightarrow 1} \sqrt{\frac{x-1}{x^2-1}}$

Answer: $\frac{1}{\sqrt{2}}$

(d) (5 points) $\lim_{x \rightarrow \infty} (\sqrt{x^2 + 15x} - x)$

Answer: $\frac{15}{2}$

- 4 (22 points) Mole Rats are introduced in Seattle when a disgruntled mole rat farmer releases her herd. For the next 5 years the population grows exponentially. After 3 years there are 10,000 mole rats. After 5 years there are 40,000 mole rats and dingos (which dine exclusively on mole rats) are introduced to control the mole rat population. Once the dingos are introduced, the mole rat population is modeled not by an exponential but by a sinusoidal function with a longterm average of 40,000 mole rats and a periodic maximum population of 60,000 mole rats. The mole rat population first begins to decrease 3 years after the dingos are introduced.

- (a) (10 points) Fill in the missing values in the table.

years	0	1	3	4	5	8	14
mole rats	1250	2500	10000	20000	40000	60000	20000

- (b) (12 points) Write a (multipart) equation for the number of mole rats as a function of years after the release.

Answer: $m(t) = \begin{cases} 1250 \cdot 2^t & \text{if } t \leq 5 \\ 40000 + 20000 \sin\left[\frac{2\pi}{12}(t-5)\right] & \text{if } t > 5 \end{cases}$

- 5 (23 points) Parametric equations for the position of an object are given by $x(t) = 15t + 4$ feet after t seconds and $y(t) = \ln(t)$ feet after t seconds.

- (a) (6 points) Find the (instantaneous) velocity in the
- x
- direction after 10 seconds.

Answer: 15 feet per second

- (b) (6 points) Find the average velocity in the
- y
- direction between 10 and 15 seconds.

Answer: $\frac{1}{5} \ln\left(\frac{3}{2}\right)$ feet per second

- (c) (6 points) Write down a limit whose value is the (instantaneous) velocity in the
- y
- direction after 10 seconds. (Do not simplify or evaluate the limit.)

Answer: $\lim_{h \rightarrow 0} \frac{\ln(10+h) - \ln(10)}{h}$ feet per second

- (d) (5 points) Find the slope at which the object is moving after 10 seconds if the velocity in the
- y
- direction is
- C
- feet per second (Your answer should involve
- C
- .)

Answer: $\frac{C}{15}$