

Your Name

Your Signature

Student ID #

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Quiz Section

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Professor's Name

TA's Name

- Give all answers with 2 decimal point accuracy.
- This exam is closed book. You may use one two-sided  $8\frac{1}{2} \times 11$ " sheet of notes.
- Graphing calculators are not allowed. Do not share calculators.
- You must show your work on all problems.
- **To receive credit, you must write your final answer to each question in the box provided.**
- If you use a trial and error (or guess and check) method when an algebraic method is available, you will not receive full credit.
- If you need more room, use the backs of the pages and indicate to the reader that you have done so.
- Raise your hand if you have a question.

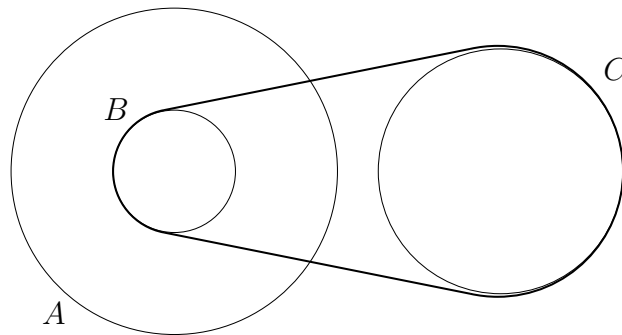
Problem	Total Points	Score
1	6	
2	10	
3	12	
4	14	
5	14	

Problem	Total Points	Score
6	10	
7	12	
8	12	
9	10	
Total	100	

1. [6 points] Let  $f(x) = \frac{3+x}{x}$ . Simplify  $\frac{f(x+h) - f(x)}{h}$  as much as possible.

Answer:

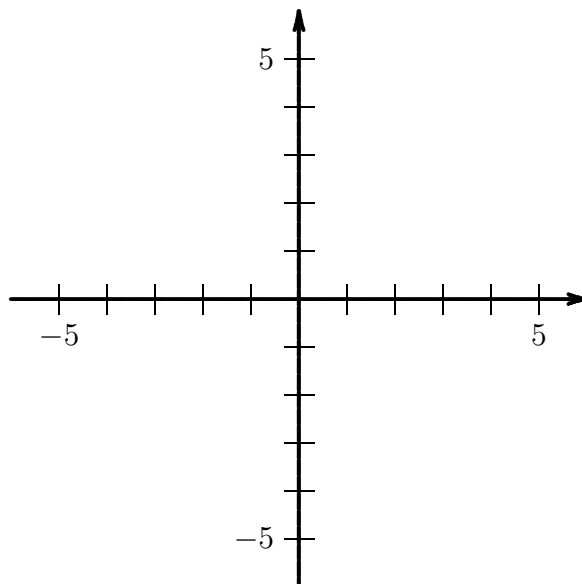
2. [10 points] Consider the belt-and-wheel configuration shown to the right. We are told that wheels  $A$  and  $B$  are connected at the hub, so that they rotate together; and also that  $B$  and  $C$  are connected by a belt. Wheel  $A$  has radius 25 cm, wheel  $B$  has radius 10 cm, and wheel  $C$  has radius 20 cm. If wheel  $A$  rotates at 200 RPM, what is the linear speed (in cm per second) of wheel  $C$ ?



Answer:

3. [12 points total] Let  $f(x) = \frac{3x - 2}{2x + 4}$ .

- (a) [5 points] Graph  $y = f(x)$  on the axes below. Show the  $y$ -intercept, any zeroes, and both horizontal and vertical asymptotes, if they occur.



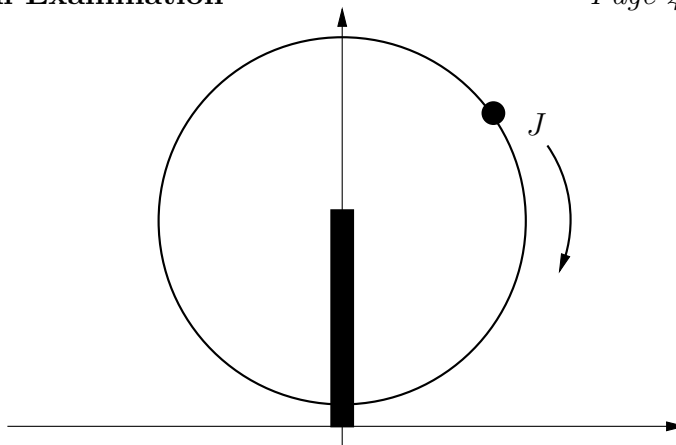
- (b) [3 points] Find the domain and range of  $f(x)$ .

Answer:

- (c) [4 points] Find  $f^{-1}(10)$ .

Answer:

4. [14 points] Jody is riding a ferris wheel of radius 45 feet. The highest point on the ride is 95 feet above the ground. The ride starts with Jody at the point  $J$ ; the wheel turns **clockwise** at  $\frac{3}{4}$  RPM. Impose a coordinate system as shown, with the origin on the ground directly below the center of the circle.



- (a) [4 points] Find Jody's angular speed in radians per second.

Answer:

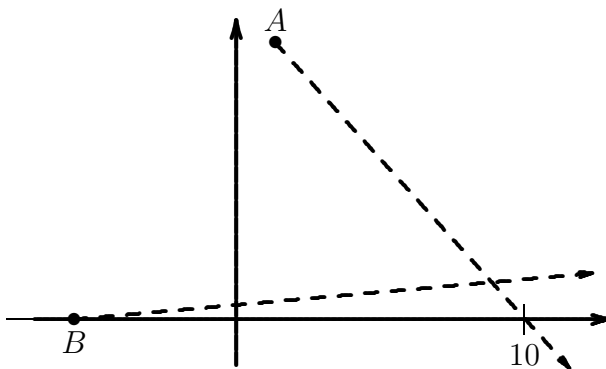
- (b) [5 points] It takes 70 seconds for Jody to reach the top of the wheel. How far has she traveled (along the arc) during these 70 seconds?

Answer:

- (c) [5 points] Find Jody's coordinates  $(x(t), y(t))$  at time  $t$  seconds.

Answer:

5. [14 points total] Two planes,  $A$  and  $B$ , are flying on crossing paths, as shown to the right. At time  $t = 0$  minutes, plane  $A$  is at the point  $(1, 12)$  in the given coordinate system, flying 150 miles per hour toward the point  $(10, 0)$ . (The coordinates here are given in miles.)



- (a) [5 points] Find the coordinates  $(x(t), y(t))$  of plane  $A$  at time  $t$  minutes.

Answer:

- (b) [4 points] Plane  $B$  has coordinates

$$x(t) = -6 + 4.5t$$

$$y(t) = 0.5t$$

at time  $t$  minutes. Find the equation of the path of plane  $B$ . (That is, write  $y$  in terms of  $x$ .)

Answer:

- (c) [5 points] Find the time  $t$  when the two planes are 5 miles apart.

Answer:

6. [10 points total] Coffee is poured into a cup and left to cool. The temperature  $T$  of the coffee (in degrees Celsius) is related to the time  $t$  (in minutes) since the cup was poured by the equation

$$t = -25 \ln \left( \frac{T - 20}{75} \right).$$

- (a) [3 points] When is the coffee  $40^\circ$  C? (The answer should be the number of minutes since the coffee was poured.)

Answer:

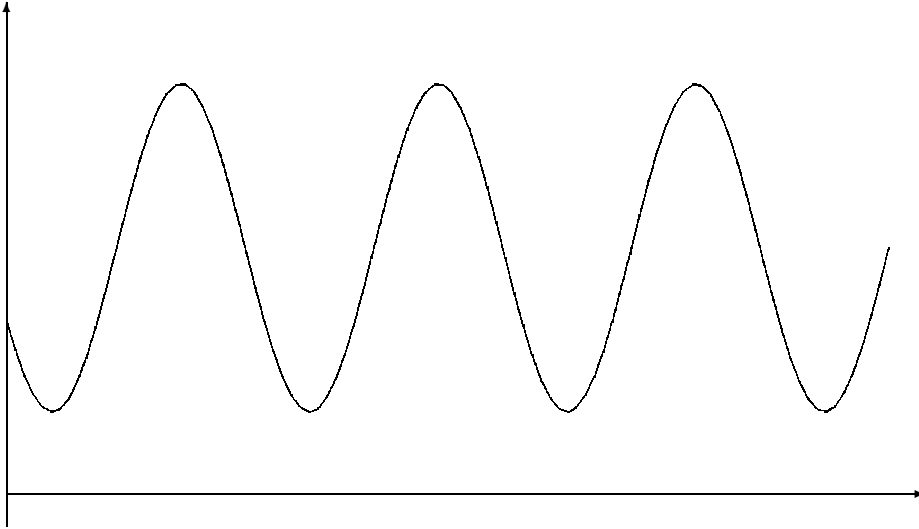
- (b) [4 points] How hot was the coffee when it was poured?

Answer:

- (c) [3 points] How hot is the coffee 10 minutes after it was poured?

Answer:

7. [12 points total] You are running a cliff-diving exhibition. Naturally, you are concerned about the depth of the water beneath the cliffs. The depth at high tide is 25 feet; the depth at low tide, which occurs three and a half hours later, is 5 feet. On one particular day, you observe that at 6:30 AM, the depth of the water is 15 feet and *falling*. Here is a graph of the depth of the water for the day in question, with  $t = 0$  representing midnight.



- (a) [4 points] Write the depth of the water as a sinusoidal model in terms of  $t$ , the hours since midnight.

Answer:

- (b) [4 points] How deep is the water at 1:00 AM?

Answer:

- (c) [4 points] To dive safely, you require the water to be at least 10 feet deep. How many hours during this 24-hour day will your divers be able to perform safely?

Answer:



8. [12 points total] Linda bought a house in 1996 for \$150,000. In 2001, it was assessed (valued) at \$210,000. Assume the value of Linda's house grows according to an exponential model.

(a) [4 points] Find a formula for the value  $H(x)$  of the house in year  $1996 + x$ .

Answer:

(b) [4 points] Linda wants to sell her house in 2005. What will the house be worth according to this model?

Answer:

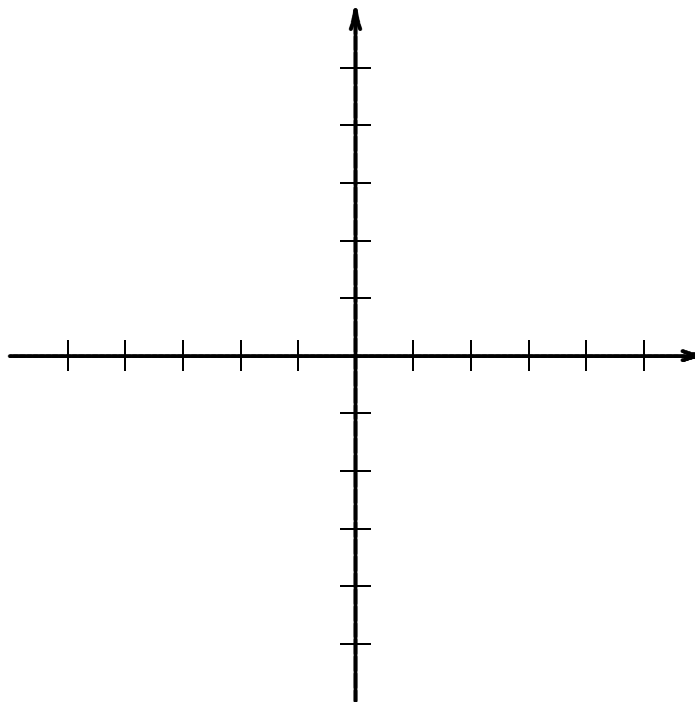
(c) [4 points] When will Linda's house be worth twice what she paid for it?

Answer:

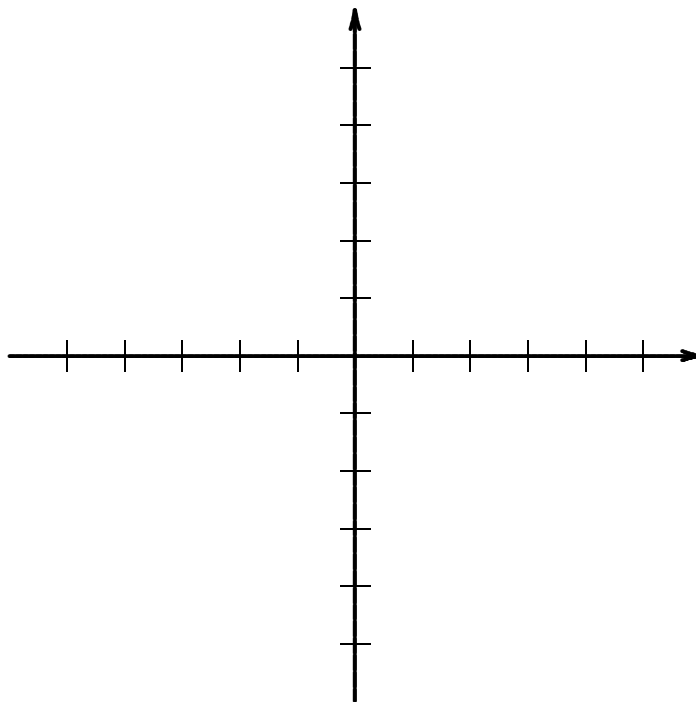
9. [10 points total] Consider the multi-part function  $f(x)$  defined on the domain  $-4 \leq x \leq 4$  by the rule

$$f(x) = \begin{cases} 2 - \frac{1}{2}x & \text{if } -4 \leq x < -2 \\ 3 + \sqrt{4 - x^2} & \text{if } -2 \leq x \leq 2 \\ 5 - x & \text{if } 2 < x \leq 4. \end{cases}$$

- (a) [4 points] On the axes to the right, graph  $y = f(x)$ .



- (b) [4 points] On the axes below, graph  $y = f(\frac{1}{2}(x - 1)) - 3$ .



- (c) [2 points] What is the largest domain on which  $y = \sqrt{f(\frac{1}{2}(x - 1)) - 3}$  is defined?

Answer: