

# Math 141 Final Exam

## Fall 2002

Version A

### Instructions

This test consists of **seven** pages besides this cover with 34 questions. **Please** be sure that you have all the pages. If you do not report otherwise it will be assumed that you were given a complete copy of the examination. The use of notes and calculators is strictly prohibited!

Please print your name \_\_\_\_\_

Please print your instructor's name \_\_\_\_\_

1. Find the solution set for the nonlinear inequality  $x^2 < x + 2$ .

- a)  $x \in (-\infty, -1)$
- b)  $x \in (2, \infty)$
- c)  $x \in [-1, 2]$
- d)  $x \in (-\infty, -1) \cup (2, \infty)$
- e)  $x \in (-1, 2)$

2. Solve the inequality  $\left|t + \frac{1}{2}\right| \geq 2$ .

- a)  $t \in (-\infty, -2] \cup [3, \infty)$
- b)  $t \in (-\infty, -\frac{1}{2}] \cup [\frac{3}{2}, \infty)$
- c)  $t \in (-\infty, -\frac{3}{2}] \cup [\frac{3}{2}, \infty)$
- d)  $t \in (-\infty, -\frac{5}{2}] \cup [\frac{3}{2}, \infty)$
- e)  $t \in (-\infty, -\frac{5}{2}] \cap [\frac{3}{2}, \infty)$

3. Find the equation of the circle with center  $(-1, 7)$  and radius  $\sqrt{2}$ .

- a)  $x^2 + 2x + y^2 - 14y + 48 = 0$
- b)  $x^2 - 2x - y^2 - 14y - 48 = 0$
- c)  $x^2 + 14x + 48 + y^2 - 2y = 0$
- d)  $x^2 - 14x + 48 + y^2 - 2y = 0$
- e)  $x^2 + 2x + y^2 - 28y + 50 = 0$

4. Find the equation of a line that is perpendicular to  $4x + 12y - 3 = 0$  and passes through the point  $(2, 3)$ .

- a)  $y = 3x - \frac{3}{2}$
- b)  $y = 3x - 3$
- c)  $y = 2x - 3$
- d)  $y = \frac{1}{3}x - 2$
- e)  $y = -\frac{1}{3}x + \frac{1}{4}$

5. Candy and Tim share a paper route. It takes Candy 70 min to deliver all the papers, whereas Tim takes 80 min. How many minutes does it take them when they work together?

- a)  $36\frac{2}{3}$
- b)  $37\frac{1}{3}$
- c)  $38\frac{1}{3}$
- d)  $39\frac{1}{3}$
- e)  $40\frac{2}{3}$

6. For the function  $f(x) = 3x^2 + 5x - 2$ , find  $\frac{f(a+h)-f(a)}{h}$ , where  $h \neq 0$ .
- $6a + 3h - 5$
  - $6a + 3h + 5$
  - $-6a - 3h + 5$
  - $6a^2 + 3a + 3h + 5$
  - $6a^2 + 3a - 3h - 5$
7. Find the domain and range of the function  $f(x) = \sqrt{2x^2 - 8}$
- Domain  $(-\infty, -2] \cup [2, \infty)$ , Range  $[4, \infty)$
  - Domain  $(-\infty, -2] \cup [2, \infty)$ , Range  $[-4, \infty)$
  - Domain  $(-\infty, -2] \cup [2, \infty)$ , Range  $[0, \infty)$
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8. Find a function whose graph is a line segment joining the points  $(5, 9)$  and  $(-2, 3)$
- $f(x) = \frac{6}{7}x + \frac{33}{7}$
  - $f(x) = -\frac{6}{7}x - \frac{13}{7}$
  - $f(x) = \frac{6}{11}x - \frac{23}{11}$
  - $f(x) = \frac{6}{7}x - \frac{11}{7}$
  - $f(x) = \frac{6}{11}x + \frac{23}{11}$
9. Given the graph of  $f$ , describe how the graph  $y = f(x + 4)$  can be obtained from the graph of  $f$ .
- By shifting 4 units to the left.
  - By shifting 4 units up.
  - By shifting 4 units down.
  - By shifting 4 units to the right.
  - By reflecting in the  $x$ -axis.
10. Find the inverse function of  $f(x) = (x - 5)^3 + 8$
- $f^{-1}(x) = x - 3$
  - $f^{-1}(x) = \sqrt[3]{x} - 117$
  - $f^{-1}(x) = \sqrt[3]{x} + 117$
  - $f^{-1}(x) = \sqrt[3]{x - 8} + 5$
  - $f^{-1}(x) = \sqrt[3]{x + 8} + 5$
11. Given  $f(x) = x^2 - 3$ ;  $g(x) = x + 1$ . Find  $(g \circ f)(x)$
- $x^2 + 2x - 2$
  - $x^2 + 2x$
  - $2x - 2$
  - $x^2 - 2$
  - $2x^2 + 2x - 2$

12. The graph below has the piecewise-defined function

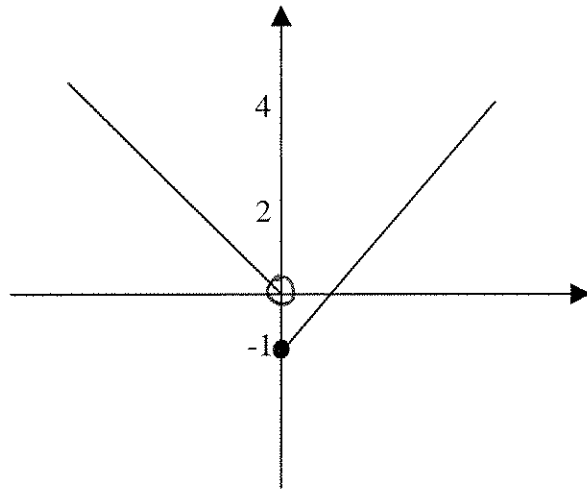
$$\text{a) } f(x) = \begin{cases} -x & \text{if } x < 0 \\ x-1 & \text{if } x \geq 0 \end{cases}$$

$$\text{b) } f(x) = \begin{cases} x & \text{if } x < 0 \\ x-1 & \text{if } x \geq 0 \end{cases}$$

$$\text{c) } f(x) = \begin{cases} -x & \text{if } x > 0 \\ x-1 & \text{if } x \geq 0 \end{cases}$$

$$\text{d) } f(x) = \begin{cases} 2 & \text{if } x < 0 \\ -3 & \text{if } x \geq 0 \end{cases}$$

$$\text{e) } f(x) = \begin{cases} 1 & \text{if } x > 0 \\ x^2 & \text{if } x \geq 0 \end{cases}$$



13. Find the quotient and remainder:

$$\frac{x^3 + 3x^2 - 7x + 6}{x - 2}$$

$$\text{a. } x^2 + 5x + 3 + \frac{12}{x-2}$$

$$\text{b. } x^2 + x - 9 + \frac{24}{x-2}$$

$$\text{c. } x^2 + 6x + 5 + \frac{6}{x-2}$$

$$\text{d. } x^2 - 6x + 5 - \frac{12}{x-2}$$

$$\text{e. } x^2 + 3x^2 - 7x + \frac{6}{x-2}$$

14. Find the real zeros of the polynomial:  $P(x) = (x+1)(x^2 - 5x + 6)$

$$\text{a. } x = 1, x = -5, \text{ and } x = 6$$

$$\text{b. } x = -1, x = 2, \text{ and } x = 3$$

$$\text{c. } x = -1, x = 1, \text{ and } x = 6$$

$$\text{d. } x = 1, x = -2, \text{ and } x = -3$$

$$\text{e. } x = -1, x = 5, \text{ and } x = -6$$

15. Find all solutions to:  $x^2 + 9 = 0$

$$\text{a. } x = \pm 3 \quad \text{b. } x = \pm i \quad \text{c. } x = \pm 3i \quad \text{d. } x = -3 \quad \text{e. no solutions}$$

16. Find a polynomial that has degree 3 and zeros at 3,  $2i$  and  $-2i$

- a.  $x^3 + 3x^2 + 4x + 12$
- b.  $3x^3 + 2x^2 - 2x + 12$
- c.  $3x^3 + x^2 + 4x - i$
- d.  $x^3 - 3x^2 + 4x - 12$
- e.  $3x^3 + 2ix^2 - 2ix$

17. Find the asymptotes of  $f(x) = \frac{3x^2 - 3}{x^2 - x - 20}$

- a.  $x = -1, x = 1$  and  $y = 0$
- b.  $x = 4, x = 5$  and  $y = 1$
- c.  $x = 1, x = 5$  and  $y = 0$
- d.  $x = 1, x = -4$  and  $y = 3$
- e.  $x = -4, x = 5$  and  $y = 3$

18. Evaluate  $\left(\frac{1}{9}\right)^{-\frac{1}{2}}$ .

- a.  $-\frac{9}{2}$
- b. 3
- c.  $-\frac{1}{3}$
- d. 9
- e.  $-\frac{1}{18}$

19. Evaluate  $\log_3 \frac{1}{27}$ .

- a.  $\frac{1}{3}$
- b. 9
- c.  $\frac{1}{9}$
- d. -3
- e. -9

20. Evaluate the expression  $\frac{1}{2} \log_3 36 - \log_3 2$ .

- a.  $\frac{1}{2} \log_3 34$
- b. 3
- c. 1
- d.  $\frac{16}{3}$
- e.  $\log_3 16$

21. Find the domain of the function  $f(x) = \log_2(x) - 3 \cdot \log_2(1-x)$ .

- a.  $(-\infty, -1) \cup (-1, 0)$       b.  $(-\infty, 0) \cup (0, \infty)$       c.  $(-\infty, 1)$       d.  $(0, 1)$       e.  $(1, \infty)$

22. Solve the equation  $\ln(4-x) - 1 = 1$  for  $x$ .

- a.  $e^2 - 4$       b. 0      c. 3      d.  $\ln 2$       e.  $4 - e^2$

23. Solve the equation  $e^{x+1} = 3$  for  $x$ .

- a.  $\ln 3 - 1$       b. 1      c.  $\ln 2$       d. 2      e.  $\ln 3 - \ln 1$

24. What is the terminal point of  $t = \frac{14}{3}\pi$  on the unit circle?

- a.  $(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}})$       b.  $(-\frac{1}{2}, \frac{\sqrt{3}}{2})$       c.  $(-1, 0)$       d.  $(-\frac{1}{2}, -\frac{\sqrt{3}}{2})$       e.  $(-\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}})$

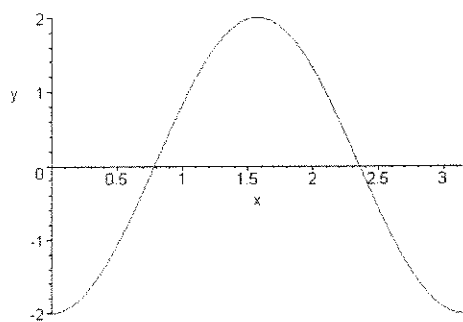
25. If the terminal point of the real number  $t$  is in quadrant III, which of the following statements are true?

$$I. \tan(t) = \frac{-\sqrt{1 - \cos^2(t)}}{\cos(t)} \quad II. \sin(t) = \sqrt{1 - \cos^2(t)} \quad III. \sin(t) = \frac{1}{\sec(t)}$$

$$IV. \sin(t) = -\sqrt{1 - \cos^2(t)} \quad V. \tan(t) = \frac{+\sqrt{1 - \cos^2(t)}}{\cos(t)}$$

- a. all of the above      b. I and II      c. I and IV      d. II and V      e. III, IV, and V

26. Which of the following functions best describes the graph of the function shown here?



- a.  $f(x) = 2\sin(x)$       b.  $f(x) = -2\cos\left(\frac{1}{2}x\right)$       c.  $f(x) = 2\cos\left(\frac{1}{2}x\right)$   
 d.  $f(x) = -2\cos(2x)$       e.  $f(x) = 2\cos(2x)$

27. Find the period of  $f(x) = 2\tan(2\pi(x-2))$

- a.  $2\pi$       b. 2      c.  $\frac{1}{2}$       d.  $\frac{\pi}{2}$       e.  $\pi$

28. Find the period and the phase shift of  $y = \sin\left(\frac{4}{3}(3x + \pi)\right)$

- a. The period is  $\frac{3}{2}\pi$  and the phase shift is  $-\pi$   
 b. The period is  $\frac{2}{3}\pi$  and the phase shift is  $-\pi$   
 c. The period is  $\frac{\pi}{2}$  and the phase shift is  $-\frac{\pi}{3}$   
 d. The period is  $\frac{\pi}{2}$  and the phase shift is  $-\pi$

29. Evaluate the given expression:  $\left(\tan\left(\frac{\pi}{4}\right)\right)\left(\cos\left(-\frac{\pi}{6}\right)\right)^2 + \sin\left(-\frac{\pi}{6}\right)$

- a.  $\frac{3}{4}$       b.  $\frac{2}{\sqrt{3}} - \frac{1}{2}$       c.  $\frac{1}{4}$       d.  $\frac{\pi}{2}$       e. 0

30. The wheels of a car have a radius of 50 cm and are rotating at 1000 rpm. What number below best approximates the speed of the car in km/h?

- a. 175      b. 180      c. 185      d. 190      e. 195

31. From the top of a 200-ft lighthouse, the angle of depression to a ship in the ocean is 30 degrees. How far is the ship from the base of the lighthouse measured in feet?

- a.  $100\sqrt{3}$     b.  $200\sqrt{3}$     c.  $100\frac{\sqrt{3}}{3}$     d.  $200\frac{\sqrt{3}}{3}$     e. There is not enough data to determine this distance.

32. If  $\tan \theta = -4$  and  $\sin \theta > 0$ , what is the value of  $\csc \theta$ ?

- a.  $\sqrt{17}$     b.  $-\sqrt{17}$     c.  $\frac{\sqrt{17}}{4}$     d.  $\frac{-\sqrt{17}}{4}$     e.  $\frac{1}{\sqrt{17}}$

33. Steve is flying two kites at the same time. He has 80 meters of line out to one kite and 100 meters to the other. He estimates the angle between the two lines to be 60 degrees. What number below most closely approximates the distance between the two kites measured in meters?

- a. 75    b. 80    c. 85    d. 90    e. 95

34. What is the value of  $\sin \frac{19\pi}{12}$ ? Hint:  $\sin(a+b) = \sin a \cos b + \cos a \sin b$  and  $\frac{7}{12} = \frac{3}{12} + \frac{4}{12}$ .

- a.  $\frac{\sqrt{2}-\sqrt{6}}{4}$     b.  $\frac{-\sqrt{2}-\sqrt{6}}{4}$     c.  $\frac{\sqrt{6}-\sqrt{3}}{4}$     d.  $\frac{-\sqrt{3}-\sqrt{6}}{4}$     e.  $\frac{\sqrt{6}-\sqrt{2}}{4}$

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## Fall 2002

Version B

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2. Solve the inequality  $\left|t + \frac{1}{2}\right| \geq 2$ .

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3. Find the equation of the circle with center  $(-1, 7)$  and radius  $\sqrt{2}$ .

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- $f(x) = \frac{6}{7}x + \frac{33}{7}$
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  - $f^{-1}(x) = \sqrt[3]{x - 8} + 5$
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11. Given  $f(x) = x^2 - 3$ ;  $g(x) = x + 1$ . Find  $(g \circ f)(x)$
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  - $x^2 - 2$
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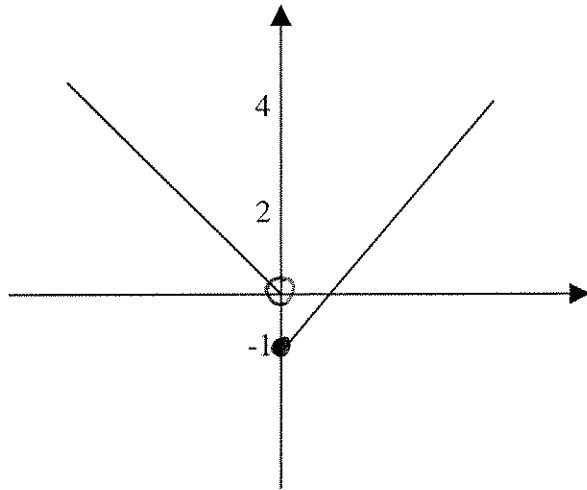
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d)  $f(x) = \begin{cases} 2 & \text{if } x < 0 \\ -3 & \text{if } x \geq 0 \end{cases}$

e)  $f(x) = \begin{cases} 1 & \text{if } x > 0 \\ x^2 & \text{if } x \geq 0 \end{cases}$



13. Find the quotient and remainder:

$$\frac{x^3 + 3x^2 - 7x + 6}{x - 2}$$

a.  $x^2 + 5x + 3 + \frac{12}{x-2}$

b.  $x^2 + x - 9 + \frac{24}{x-2}$

c.  $x^2 + 6x + 5 + \frac{6}{x-2}$

d.  $x^2 - 6x + 5 - \frac{12}{x-2}$

e.  $x^2 + 3x^2 - 7x + \frac{6}{x-2}$

14. Find the real zeros of the polynomial:  $P(x) = (x+1)(x^2 - 5x + 6)$

a.  $x = 1$ ,  $x = -5$ , and  $x = 6$

b.  $x = -1$ ,  $x = 2$ , and  $x = 3$

c.  $x = -1$ ,  $x = 1$ , and  $x = 6$

d.  $x = 1$ ,  $x = -2$ , and  $x = -3$

e.  $x = -1$ ,  $x = 5$ , and  $x = -6$

15. Find all solutions to:  $x^2 + 9 = 0$

a.  $x = \pm 3$     b.  $x = \pm i$     c.  $x = \pm 3i$     d.  $x = -3$     e. no solutions

16. Find a polynomial that has degree 3 and zeros at 3,  $2i$  and  $-2i$

- a.  $x^3 + 3x^2 + 4x + 12$
- b.  $3x^3 + 2x^2 - 2x + 12$
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- d.  $x^3 - 3x^2 + 4x - 12$
- e.  $3x^3 + 2ix^2 - 2ix$

17. Find the asymptotes of  $f(x) = \frac{3x^2 - 3}{x^2 - x - 20}$

- a.  $x = -1, x = 1$  and  $y = 0$
- b.  $x = 4, x = 5$  and  $y = 1$
- c.  $x = 1, x = 5$  and  $y = 0$
- d.  $x = 1, x = -4$  and  $y = 3$
- e.  $x = -4, x = 5$  and  $y = 3$

18. Evaluate  $\left(\frac{1}{9}\right)^{-\frac{1}{2}}$ .

- a.  $-\frac{9}{2}$
- b. 3
- c.  $-\frac{1}{3}$
- d. 9
- e.  $-\frac{1}{18}$

19. Evaluate  $\log_3 \frac{1}{27}$ .

- a.  $\frac{1}{3}$
- b. 9
- c.  $\frac{1}{9}$
- d. -3
- e. -9

20. Evaluate the expression  $\frac{1}{2} \log_3 36 - \log_3 2$ .

- a.  $\frac{1}{2} \log_3 34$
- b. 3
- c. 1
- d.  $\frac{16}{3}$
- e.  $\log_3 16$

21. Find the domain of the function  $f(x) = \log_2(x) - 3 \cdot \log_2(1-x)$ .

- a.  $(-\infty, -1) \cup (-1, 0)$       b.  $(-\infty, 0) \cup (0, \infty)$       c.  $(-\infty, 1)$       d.  $(0, 1)$       e.  $(1, \infty)$

22. Solve the equation  $\ln(4-x) - 1 = 1$  for  $x$ .

- a.  $e^2 - 4$       b. 0      c. 3      d.  $\ln 2$       e.  $4 - e^2$

23. Solve the equation  $e^{x+1} = 3$  for  $x$ .

- a.  $\ln 3 - 1$       b. 1      c.  $\ln 2$       d. 2      e.  $\ln 3 - \ln 1$

24. What is the terminal point of  $t = \frac{14}{3}\pi$  on the unit circle?

- a.  $(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}})$       b.  $(-\frac{1}{2}, \frac{\sqrt{3}}{2})$       c.  $(-1, 0)$       d.  $(-\frac{1}{2}, -\frac{\sqrt{3}}{2})$       e.  $(-\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}})$

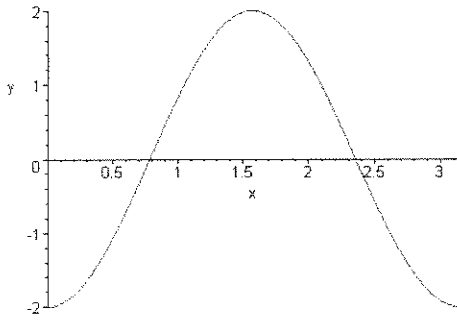
25. If the terminal point of the real number  $t$  is in quadrant III, which of the following statements are true?

$$I. \tan(t) = \frac{-\sqrt{1 - \cos^2(t)}}{\cos(t)} \quad II. \sin(t) = \sqrt{1 - \cos^2(t)} \quad III. \sin(t) = \frac{1}{\sec(t)}$$

$$IV. \sin(t) = -\sqrt{1 - \cos^2(t)} \quad V. \tan(t) = \frac{+\sqrt{1 - \cos^2(t)}}{\cos(t)}$$

- a. all of the above      b. I and II      c. I and IV      d. II and V      e. III, IV, and V

26. Which of the following functions best describes the graph of the function shown here?



- a.  $f(x) = 2\sin(x)$       b.  $f(x) = -2\cos\left(\frac{1}{2}x\right)$       c.  $f(x) = 2\cos\left(\frac{1}{2}x\right)$   
 d.  $f(x) = -2\cos(2x)$       e.  $f(x) = 2\cos(2x)$

27. Find the period of  $f(x) = 2\tan(2\pi(x-2))$

- a.  $2\pi$       b. 2      c.  $\frac{1}{2}$       d.  $\frac{\pi}{2}$       e.  $\pi$

28. Find the period and the phase shift of  $y = \sin\left(\frac{4}{3}(3x + \pi)\right)$

- a. The period is  $\frac{3}{2}\pi$  and the phase shift is  $-\pi$   
 b. The period is  $\frac{2}{3}\pi$  and the phase shift is  $-\pi$   
 c. The period is  $\frac{\pi}{2}$  and the phase shift is  $-\frac{\pi}{3}$   
 d. The period is  $\frac{\pi}{2}$  and the phase shift is  $-\pi$

29. Evaluate the given expression:  $\left(\tan\left(\frac{\pi}{4}\right)\right)\left(\cos\left(-\frac{\pi}{6}\right)\right)^2 + \sin\left(-\frac{\pi}{6}\right)$

- a.  $\frac{3}{4}$       b.  $\frac{2}{\sqrt{3}} - \frac{1}{2}$       c.  $\frac{1}{4}$       d.  $\frac{\pi}{2}$       e. 0

30. The wheels of a car have a radius of 50 cm and are rotating at 1000 rpm. What number below best approximates the speed of the car in km/h?

- a. 175      b. 180      c. 185      d. 190      e. 195

31. From the top of a 200-ft lighthouse, the angle of depression to a ship in the ocean is 30 degrees. How far is the ship from the base of the lighthouse measured in feet?

- a.  $100\sqrt{3}$     b.  $200\sqrt{3}$     c.  $100\frac{\sqrt{3}}{3}$     d.  $200\frac{\sqrt{3}}{3}$     e. There is not enough data to determine this distance.

32. If  $\tan \theta = -4$  and  $\sin \theta > 0$ , what is the value of  $\csc \theta$ ?

- a.  $\sqrt{17}$     b.  $-\sqrt{17}$     c.  $\frac{\sqrt{17}}{4}$     d.  $\frac{-\sqrt{17}}{4}$     e.  $\frac{1}{\sqrt{17}}$

33. Steve is flying two kites at the same time. He has 80 meters of line out to one kite and 100 meters to the other. He estimates the angle between the two lines to be 60 degrees. What number below most closely approximates the distance between the two kites measured in meters?

- a. 75    b. 80    c. 85    d. 90    e. 95

34. What is the value of  $\sin \frac{19\pi}{12}$ ? Hint:  $\sin(a+b) = \sin a \cos b + \cos a \sin b$  and  $\frac{7}{12} = \frac{3}{12} + \frac{4}{12}$ .

- a.  $\frac{\sqrt{2}-\sqrt{6}}{4}$     b.  $\frac{-\sqrt{2}-\sqrt{6}}{4}$     c.  $\frac{\sqrt{6}-\sqrt{3}}{4}$     d.  $\frac{-\sqrt{3}-\sqrt{6}}{4}$     e.  $\frac{\sqrt{6}-\sqrt{2}}{4}$