Math 120r
Final Exam Study Guide

The following problems are intended as review of the topics covered in this course and as practice for answering questions in a multiple choice format. These do not represent the actual problems you will see on the final exam.

1. Find the value of c so that the lines $5x + cy = 4$ and $x - 3y = 9$ are perpendicular.

(A) $c = -3$ (B) $c = 15$ (C) $c = -15$ (D) $c = -\frac{5}{3}$ (E) $c = \frac{5}{3}$

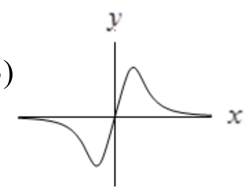
2. Find the value of k so that the slope of the line connecting the points $(k, 4)$ and $(-k, 9)$ is 3.

(A) $k = -\frac{15}{2}$ (B) $k = -\frac{6}{5}$ (C) $k = -\frac{5}{6}$ (D) $k = \frac{5}{6}$ (E) $k = \frac{15}{2}$

3. Which of the following represent y as a function of x?

(1) $xy + 2 = x$

(2) $x^2 + y^2 = 64$

(3) 

(4)

x	y
0	5
2	5
4	5
6	5

(A) (2) only (B) (1), (3), and (4) only (C) (1) and (2) only

(D) (3) and (4) only (E) (1), (2), (3), and (4)

4. Find the x-intercept(s) of the piecewise defined function:

$$f(x) = \begin{cases} -3x + 5 & \text{if } x < -5 \\ x^2 - 8 & \text{if } -5 \le x \le -1 \\ \sqrt{x+9} & \text{if } x > -1 \end{cases}$$

(A) $x = -\sqrt{8}$ only (B) $x = -\sqrt{8}$ and $x = \sqrt{8}$ only

(C) $x = \frac{5}{3}$ only (D) $x = \frac{5}{3}$, $x = -9$, $x = -\sqrt{8}$ and $x = \sqrt{8}$ only

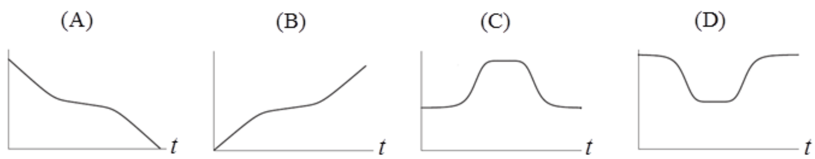
(E) There are no x-intercepts.

5. Which ONE of the following is the solution to the inequality $y^2(5y+3)(y-6) > 0$?

(A) $\left(-\frac{3}{5}, 6\right)$ (B) $\left[-\frac{3}{5}, 6\right]$ (C) $\left(-\infty, -\frac{3}{5}\right) \cup (6, \infty)$

(D) $\left(-\infty, -\frac{3}{5}\right] \cup [6, \infty)$ (E) all real numbers

Use the story and graphs below to answer questions 6 and 7.
As I drove on the freeway this morning, at first traffic was fast as usual, then it moved slowly until we passed a construction area, after which traffic flow went back to normal until I exited the freeway.



6. Which graph above represents my distance from the exit as a function of time on the freeway?
(A) (B) (C) (D)

7. Which graph above represents my driving speed as a function of time on the freeway?
(A) (B) (C) (D)

8. If $f(x)$ is a function with domain $[-8,12]$, find the domain of $\frac{1}{2}f(x-3)$.

(A) $[-5,6]$ (B) $[-7,12]$ (C) $[-5,15]$ (D) $[-11,9]$ (E) $[-13,12]$

9. Solve for y: $4y^{-2} = y$

(A) $y = \sqrt[3]{4}$ only. (B) $y = 0$ only. (C) $y = 0$ or $y = \sqrt[3]{4}$ only.

(D) $y = \frac{1}{4}$ only. (E) $y = \sqrt[3]{4}$ or $y = -\sqrt[3]{4}$ only.

10. Let $g(x) = x + 4$. Simplify $[g(x)]^2 - g(x^2)$.

(A) $8x + 12$ (B) $8x + 20$ (C) 12
(D) 0 (E) None of these

11. If $f(x)$ is a one-to-one function, and $f(8) = 11$, then which of the following CANNOT be true?

(A) $f(11) = 8$ (B) $f^{-1}(11) = 8$ (C) $f^{-1}(5) = 3$
(D) $f^{-1}(11) = 5$ (E) $f(-8) = -11$

12. Suppose $g(4) = 30$ means the volume of water in a container is 30 ounces when the depth of the water is 4 inches. What is the meaning of $g^{-1}(50) = 10$?

(A) The volume of the water is 10 ounces when the depth of the water is 50 inches.
(B) The depth of the water is 10 inches when the volume of the water is 50 ounces.
(C) The depth of the water is 0.2 inches when the volume of the water is 50 ounces.
(D) The volume of the water is 5 ounces when the depth of the water is 10 inches.
(E) None of these

13. Consider the functions $f(x)$ and $g(x)$ in the tables below.

x	$f(x)$
5	1
6	4
7	2
8	3

x	$g(x)$
2	-1
3	-4
4	-2
5	-3

Which ONE of the following expresses the correct relationship between $f(x)$ and $g(x)$?

(A) $g(x) = -f(x) + 3$ (B) $g(x) = f(-x + 3)$ (C) $g(x) = -f(x + 3)$

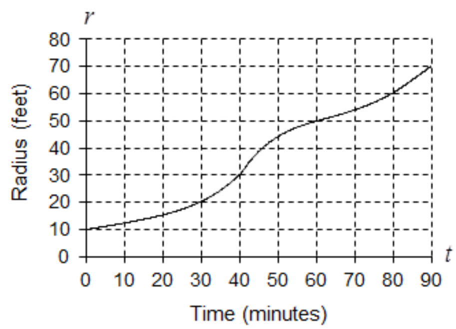
(D) $g(x) = f(-x) - 3$ (E) $g(x) = -f(x - 3)$

14. Let $h(x)=-7x+2$ and $g(x)=x^3$. Find the *x*-intercept(s) of $h(g(x))$.

(A) $x=-\frac{2}{7}$, $x=\frac{2}{7}$ (B) $x=\frac{2}{7}$ (C) $x=\sqrt[3]{\frac{2}{7}}$

(D) $x=-\sqrt[3]{\frac{2}{7}}$, $x=\sqrt[3]{\frac{2}{7}}$ (E) $x=-\sqrt[3]{\frac{7}{2}}$

Use the story and graph below to answer questions 15 and 16.
Suppose an oil spill covers a circular area and the radius, *r*, increases according to the graph shown below where *t* represents the number of minutes since the spill was first observed.



15. How large is the circular area of the spill 30 minutes after it was first observed?

(A) 900π ft² (B) 1600π ft² (C) 400 ft²

(D) 40π ft² (E) 400π ft²

16. If the cost to clean the oil spill is proportional to the square of the diameter of the spill, express the cost, C, as a function of the radius of the spill, r.

(A) $C(r)=k(2r)^{1/2}$ (B) $C(r)=k(2r)^2$ (C) $C(d)=kd^2$

(D) $C(r)=2kr^2$ (E) $C(r)=2kr^{1/2}$

17. If $p(x)=\frac{5}{x}$ and $r(x)=\frac{3}{x^2}-1$, find $\left(\frac{p}{r}\right)(x)$ for $x\neq 0$.

(A) $\frac{5x}{3-x^2}$ (B) $\frac{5x-1}{3}$ (C) $\frac{5}{3-x^2}$

(D) $\frac{5(x-1)}{3x}$ (E) $\frac{5x^2}{3-x^2}$

18. Find $\dfrac{g(3+h)-g(3)}{h}$ for $g(t)=4t^2$. Simplify your answer as much as possible.

(A) 1 (B) $24+4h$ (C) $6+h$

(D) $4h$ (E) $\dfrac{4h^2+24h+36}{h}$

19. If the point *(8, –3)* is on the graph of *f (x)*, find the corresponding point on the graph of the transformation $y = 2f(-x)$.

(A) $(16,6)$ (B) $(4,3)$ (C) $(-16,-3)$ (D) $(-8,-6)$ (E) $(-8,6)$

20. If the domain of *g(x)* is *[–5, 8]*, what is the domain of the function $y = g(x+2) - 1$?

(A) $[-7,6]$ (B) $[-3,9]$ (C) $[-4,6]$ (D) $[-7,7]$ (E) $[-3,10]$

21. Suppose $x=6$ is a vertical asymptote of a function $y=h(x)$. Which ONE of the following must be a vertical asymptote of $y=2h(3x)$?

(A) $x=6$ (B) $x=3$ (C) $x=12$ (D) $x=18$ (E) $x=2$

22. Which of the following represents the complete factorization of $2(3x+1)^7-16x(3x+1)^6$?

(A) $2(3x+1)^6(1+11x)$ (B) $2(3x+1)^6(1-4x)$

(C) $2(3x+1)^6(1-5x)$ (D) $2(3x+1)^6(1-11x)$

(E) $2(3x+1)(1-4x)$

23. Let $f(x) = \frac{2}{x}$ and $g(x) = \frac{17}{x^2} + 1$. Find and simplify $f(g(x))$ completely.

(A) $\frac{2}{17 + x^2}$ (B) $\frac{x^2}{9}$ (C) $\frac{2x^2}{17 + x^2}$

(D) $\frac{17x^2 + 4}{4}$ (E) $17x^2 + 1$

24. Let $f(t) = \sqrt{3t - 1}$. Find $f^{-1}(4)$.

(A) $\frac{17}{3}$ (B) $\sqrt{13}$ (C) 5 (D) $\sqrt{11}$ (E) 4

25. The function $S = f(b)$ gives a student's score on a standardized test as a function of the number of books b the student has read . If S is invertible, what does $f^{-1}(35) = 20$ mean?

(A) The student's score increases by 35/20 for every additional book the student reads.

(B) When the student's score is 20, the student has read 35 books.

(C) The student's score increases by 20/35 for every additional book the student reads.

(D) When the student's score is 35, the student has read 20 books.

(E) There is not enough information to determine the meaning.

Use the following tables of values to answer questions 26, 27, 28, and 29. Assume the functions are continuous, have domain all real numbers, and the characteristics of the functions are represented in the table.

x	$f(x)$
-5	3
-1	3
0	3
1	3
5	3

x	$g(x)$
-4	6
-2	10
0	0
2	-10
4	-6

x	$h(x)$
-3	-7
-1	-5
0	2
1	5
3	7

x	$k(x)$
-8	-5
-4	-1
0	0
4	-1
8	-5

26. Which of the functions could be an odd function?
(A) $f(x)$ (B) $g(x)$ (C) $h(x)$ (D) $k(x)$ (E) None of these

27. Find $h(k(-4))$.
(A) 5 (B) 0 (C) -7 (D) -1 (E) -5

28. Find the average rate of change of $g(x)$ over the interval $[-2,2]$.
(A) 5 (B) 0 (C) -5 (D) -20 (E) undefined

29. Find $(k-g)(4)$.
(A) 5 (B) -7 (C) 20 (D) -28 (E) -5

30. Which statement is true about the function $f(x)=-3(x-p)^2+q$, provided that $p \neq q$?
(A) q is the maximum value of $f(x)$ (B) p is the maximum value of $f(x)$
(C) q is the minimum value of $f(x)$ (D) p is the minimum value of $f(x)$

31. Determine whether $f(x) = 2x^2 - 6x + k$ has a maximum or minimum value.

(A) Maximum value: k

(B) Minimum value: k

(C) Maximum value: $k - \frac{9}{2}$

(D) Minimum value: $k - \frac{9}{2}$

(E) Minimum value: $k + \frac{9}{2}$

32. Solve the equation $6x(x-1) + 5x = 2$.

(A) $x = \frac{-2}{3},\ x = \frac{1}{2}$

(B) $x = 1,\ x = \frac{1}{2}$

(C) $x = \frac{2}{3},\ x = \frac{-1}{2}$

(D) $x = 0,\ x = \frac{-1}{2}$

(E) $x = \frac{1}{3},\ x = 3$

33. Suppose the graph of a polynomial function $y = f(x)$ has the following end behavior:

$y \to -\infty$ as $x \to \infty$

$y \to -\infty$ as $x \to -\infty$

Which ONE of the following statements must be true?

(A) The degree of $f(x)$ is an odd number.

(B) $f(x)$ is an even function.

(C) $f(x)$ has a minimum value.

(D) The range of $f(x)$ is all real numbers.

(E) The leading coefficient of $f(x)$ is a negative number.

34. Solve for x: $\frac{x^2 - 6x}{x+2} = 0$

(A) $x = 0, x = 6,$ or $x = -2$ only

(B) $x = 6$ only

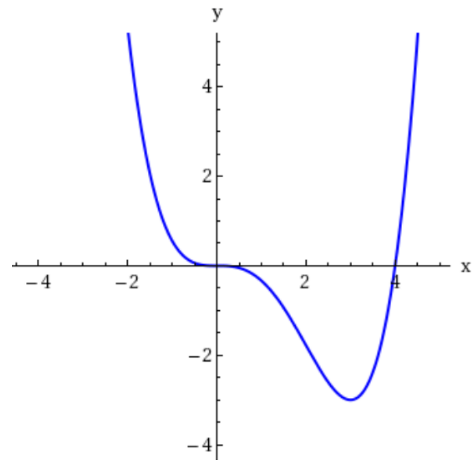
(C) $x = 0$ or $x = 6$ only

(D) $x = -2$ only

(E) $x = 6$ or $x = -2$ only

35. The graph of a polynomial function is given at the right. Assume all the characteristics of the polynomial are shown.

Which of the following could be a possible equation for the polynomial with $k > 0$?



(A) $p(x) = -kx^3(x-4)$ (B) $p(x) = kx^2(x-4)^2$
(C) $p(x) = -kx(x-4)$ (D) $p(x) = kx(x-4)$
(E) $p(x) = kx^3(x-4)$

36. Find the value of A so that $y = -4$ is the horizontal asymptote of $g(x) = \dfrac{3x+7}{Ax-2}$.

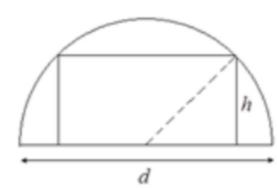
(A) $A = -\dfrac{4}{3}$ (B) $A = -\dfrac{3}{4}$ (C) $A = -\dfrac{1}{2}$

(D) $A = -2$ (E) None of these

37. Find the value of p so that the vertical asymptote of $f(x) = \dfrac{6px}{4x+p}$ is $x = 5$.

(A) $p = \dfrac{10}{3}$ (B) $p = -20$ (C) $p = -\dfrac{5}{4}$
(D) $p = 10$ (E) None of these

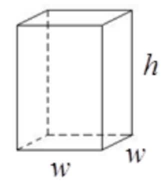
38. A rectangle is inscribed in a semicircle with diameter 10 centimeters as shown. Express the area of the rectangle as a function of the height of the rectangle.



(A) $A(h) = 2h\sqrt{25-h^2}$ (B) $A(h) = h\sqrt{10-h^2}$

(C) $A(h) = 2h\sqrt{5-h^2}$ (D) $A(h) = 2h\sqrt{10-h^2}$ (E) $A(h) = h\sqrt{25-h^2}$

39. An open top rectangular box with a square bottom has a volume of 120 cubic meters. Its bottom and sides are made from two different materials. It costs 10 dollars per square meter for the bottom material and 12 dollars per square meter for the sides. Determine a model for cost of materials as a function of w.



(A) $C(w) = 20w^2 + \frac{5760}{w}$ (B) $C(w) = 10w^2 + \frac{11520}{w}$

(C) $C(w) = 10w^2 + \frac{5760}{w}$ (D) $C(w) = 20w^2 + \frac{1440}{w}$ (E) $C(w) = 10w^2 + \frac{1440}{w}$

40. The police can determine the speed, *S,* that a car was traveling from the length of the skid mark, *L*, that the car leaves. Assuming *S* varies directly with the square root of *L,* express *S* as a function of *L.*

(A) $S(L) = kL^2$ (B) $S(L) = k\sqrt{L}$ (C) $L(S) = kS^2$

(D) $S(L) = k\sqrt{S}$ (E) $L(S) = kS$

41. The distance traveled by a falling object is directly proportional to the square of the time it takes to fall that far. If the object falls 100 feet in 2.5 seconds, how far does it fall in 5 seconds?

(A) 800 feet (B) 400 feet (C) 325 feet

(D) 250 feet (E) 200 feet

Use the story below to answer questions 42 and 43.

A printer was purchased for P_0 dollars in 2016. The value of the printer in dollars, *P*, can be expressed as a function of *t*, the number of years since 2016.

42. Write a formula for *P* if the value of the printer decreases by $15 every year.

(A) $P(t) = P_0 - 15t$ (B) $P(t) = 15t - P_0$ (C) $P(t) = P_0(1-15t)$

(D) $P(t) = P_0(t-15)$ (E) $P(t) = P_0 + (t-15)$

43. Write a formula for *P* if the value of the printer decreases by 7% each year.

(A) $P(t) = P_0(0.07)^t$ (B) $P(t) = P_0 - (0.07)^t$ (C) $P(t) = P_0(0.93)^t$

(D) $P(t) = P_0(0.3)^t$ (E) $P(t) = P_0 - P_0(0.93)^t$

44. Solve for y: $xy + a = x^3 + \frac{1}{a}y$

(A) $y = \frac{ax^3 - a^2}{ax-1}$ (B) $y = \frac{x^3 - a^2}{x-1}$ (C) $y = \frac{ax^3 - a^2}{x-1}$

(D) $y = \frac{ax-1}{ax^3 - a^2}$ (E) $y = \frac{ax^3 - a}{ax-1}$

45. Solve the inequality $\frac{(9y+11)(y-6)}{y^2} \le 0$.

(A) $\left(-\infty, -\frac{11}{9}\right] \cup [6, \infty)$ (B) $(-\infty, 0) \cup (0, \infty)$ (C) $(0, 6]$

(D) $\left[-\frac{11}{9}, 0\right) \cup (0, 6]$ (E) $\left[-\frac{11}{9}, 6\right]$

46. Use the information below to find the vertical asymptote(s) of $f(x) = \dfrac{n(x)}{d(x)}$

$n(x)$ is a quadratic function with zeroes $x = 6$ and $x = 18$

$d(x)$ is a linear function with zero $x = 9$

(A) None (B) $x = 0$ (C) $x = 6, x = 18, x = 9$

(D) $x = 6, x = 18$ (E) $x = 9$

47. Suppose $\cot\theta > 0$ and $\sec\theta < 0$. In which quadrant could θ terminate?

(A) Quadrant I (B) Quadrant II

(C) Quadrant III (D) Quadrant IV

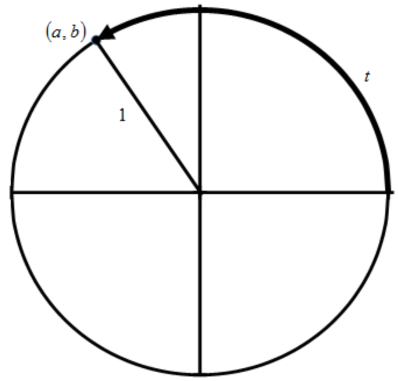
48. Find the terminal point (x, y) on the unit circle determined by the real number $t = \dfrac{3\pi}{4}$.

(A) $\left(\dfrac{\sqrt{2}}{2}, \dfrac{\sqrt{2}}{2}\right)$ (B) $\left(\dfrac{\sqrt{2}}{2}, -\dfrac{\sqrt{2}}{2}\right)$ (C) $\left(-\dfrac{\sqrt{2}}{2}, -\dfrac{\sqrt{2}}{2}\right)$

(D) $\left(-\dfrac{\sqrt{2}}{2}, \dfrac{\sqrt{2}}{2}\right)$ (E) $\left(-\dfrac{\sqrt{3}}{2}, \dfrac{1}{2}\right)$

Use the information and graph to answer questions 49 and 50.

Suppose a real number t determines the terminal point (a, b) on the unit circle. See the graph at the right.



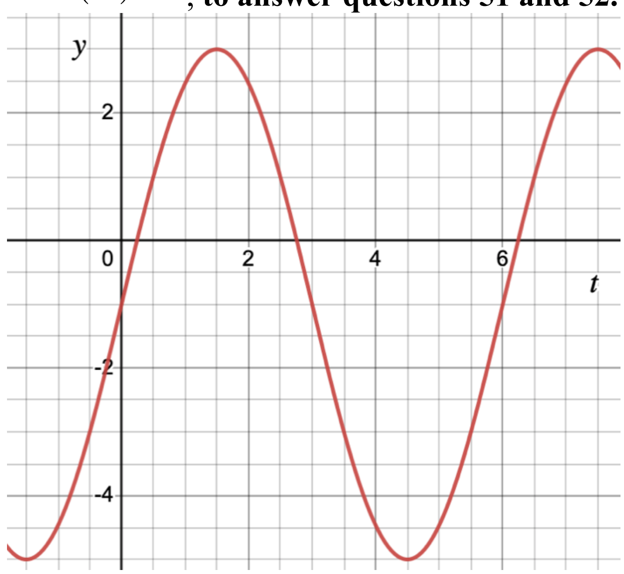
49. Find the terminal point determined by the real number $-t$.

(A) (b, a) (B) $(-a, b)$ (C) (a, b)
(D) $(-a, -b)$ (E) $(a, -b)$

50. Find $\sin(t+\pi)$.

(A) b (B) a (C) $-b$ (D) $-a$ (E) None of these

Use the graph of $f(t) = A\sin(Bt) + C$, to answer questions 51 and 52.



51. Determine the value of B.

(A) $B = \frac{\pi}{3}$ (B) $B = \frac{\pi}{2}$ (C) $B = 6$ (D) $B = 3\pi$ (E) $B = 12$

52. Determine the value of C.

(A) $C = 6$ (B) $C = 0$ (C) $C = -1$ (D) $C = 4$ (E) $C = -5$

53. In a region of Australia, the population of a particular type of kangaroo is modeled by the function $P(t)=1300-140\sin(2t)$, where t is measured in years. According to the model, what is the maximum kangaroo population?

(A) 1160 (B) 1440 (C) 1300 (D) 1580 (E) There is no largest number.

54. The minimum value of $g(x)=-37\cos(x-3)+21$ is

(A) -58 (B) -16 (C) 37 (D) 21 (E) 16

55. Which ONE of the following is a vertical asymptote of the graph of $f(x)=\tan\left(x+\frac{\pi}{3}\right)$?

(A) $x=-\frac{\pi}{3}$ (B) $x=-\frac{\pi}{6}$ (C) $x=0$ (D) $x=\frac{\pi}{6}$ (E) $x=\frac{2\pi}{3}$

56. The domain of $f(t)=\cos^{-1}(t)$ is:

(A) $[0,2\pi]$ (B) $\left[-\frac{\pi}{2},\frac{\pi}{2}\right]$ (C) $(-\infty,\infty)$ (D) $[0,\pi]$ (E) $[-1,1]$

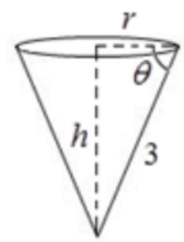
57. Simplify the expression $\tan\left(\sin^{-1}\left(\frac{x}{3}\right)\right)$. Assume $0<x<3$.

(A) $\frac{x}{3-x}$ (B) $\frac{x}{3}$ (C) $\frac{\sqrt{x^2-9}}{3}$ (D) $\frac{x}{\sqrt{9-x^2}}$ (E) $\frac{\sqrt{9-x^2}}{x}$

58. Find the length of an arc that subtends a central angle of 135° in a circle with radius 5. The length of the arc is:

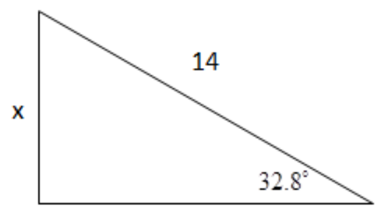
(A) 675π (B) 675 (C) $\frac{27\pi}{4}$ (D) $\frac{3\pi}{20}$ (E) $\frac{15\pi}{4}$

59. Express the volume of a cone as a function of θ.
(The formula for the volume of a cone is $V = \frac{1}{3}\pi r^2 h$.)



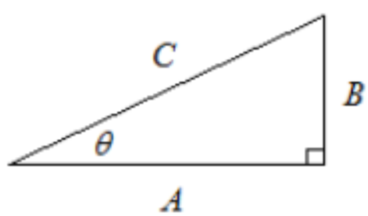
(A) $V = 9\pi\sin^2\theta\cos\theta$
(B) $V = 9\pi\cos^2\theta\sin\theta$
(C) $V = 3\pi\cos^2\theta\sin\theta$
(D) $V = 3\pi\sin\theta\cos\theta$
(E) $V = 3\pi\sin^2\theta\cos\theta$

60. Use the angle 32.8° to determine the exact value of x in the figure below.



(A) $x = 14\sin(32.8^\circ)$
(B) $x = \dfrac{\cos(32.8^\circ)}{14}$
(C) $x = 14\tan(32.8^\circ)$
(D) $x = \dfrac{14}{\sin(32.8^\circ)}$
(E) $x = 14\cos(32.8^\circ)$

61. Consider a right triangle with an acute angle given by $\theta = arcsin\,(\frac{2}{5})$, as shown below.



If the hypotenuse of the triangle has length 10, determine the length of side A.

(A) $2\sqrt{21}$
(B) $\sqrt{21}$
(C) $\sqrt{29}$
(D) $2\sqrt{26}$
(E) 2

62. Let $\cos\phi = -0.4$. Determine the value of $\cos(-\phi)$.

(A) -0.4
(B) $\pi - 0.4$
(C) $\pi + 0.4$
(D) $2\pi - 0.4$
(E) 0.4

63. Which ONE of the following angles is coterminal with -245°?

(A) -115° (B) 25° (C) 65° (D) 115° (E) 245°

64. What can we say about the y-values of the graph of $f(x)=13x(x+2)^3$ as $x\to-\infty$?

(A) $y\to-\infty$ (B) $y\to\infty$ (C) $y\to2$
(D) $y\to13$ (E) $y\to0$

65. What can we say about the y-values of $tan^{-1}(x)$ as $x\to\ \infty$?

(A) $y\to\ \infty$ (B) $y\to\ \frac{\pi}{4}$ (C) $y\to\ \frac{\pi}{2}$

(D) $y\to\ \frac{-\pi}{2}$ (E) $y\to\ 0$

66. Simplify the expression $\sin A(\csc A-\sin A)$.

(A) $1-\cos A$ (B) $\sin^2 A$ (C) 1
(D) $1-\sin A$ (E) $\cos^2 A$

67. Suppose sin(x) = –5/13, where x terminates in Quadrant III. Find sin(2x).

(A) $\frac{120}{169}$ (B) $\frac{8}{13}$ (C) $-\frac{10}{13}$

(D) $-\frac{120}{169}$ (E) $-\frac{8}{13}$

68. Solve for *t*: $(2\cos t - 1)(\cos t - 2) = 0$ on the interval $0 \le t < 2\pi$.

(A) $t = 0$, $t = \pi$, $t = \frac{\pi}{3}$, or $t = \frac{5\pi}{3}$ only.

(B) $t = 0$ or $t = \pi$ only.

(C) $t = \frac{\pi}{3}$ or $t = \frac{5\pi}{3}$ only.

(D) $t = \frac{\pi}{6}$ or $t = \frac{11\pi}{6}$ only.

(E) $t = 0$, $t = \pi$, $t = \frac{\pi}{6}$, or $t = \frac{11\pi}{6}$ only.

69. Solve for *x*: $\frac{\sin(3x) - 2}{\cos 3x} = 0$ on the interval $0 \le x < \frac{\pi}{2}$

(A) $x = \frac{\pi}{6}$ only

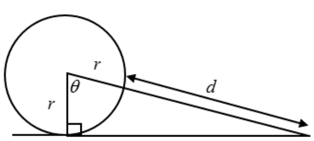
(B) $x = \frac{\tan^{-1}(2)}{3}$ only

(C) $x = 0$ only

(D) $x = \sin^{-1}\left(\frac{2}{3}\right)$ only

(E) No solution

70. The radius of the circle below is 18 inches. Express the length *d* as shown in terms of θ.



(A) $d(\theta) = \frac{18}{\cos(\theta)} - 18$

(B) $d(\theta) = \frac{18}{\cos(\theta)} + 18$

(C) $d(\theta) = 18\cos(\theta) - 18$

(D) $d(\theta) = 18\cos(\theta) + 18$

(E) $d(\theta) = \frac{18}{\cos(\theta)}$

71. The range of $f(t) = -3^t + 200$ is:

(A) $(-\infty, \infty)$ (B) $(-\infty, 0)$ (C) $(-\infty, 200)$

(D) $(200, \infty)$ (E) $(0, \infty)$

72. Find the inverse function of $h(t) = 7^t + 19$.

(A) $h^{-1}(t) = \log_{19}(t-7)$ (B) $h^{-1}(t) = \log_7(t-19)$

(C) $h^{-1}(t) = -19 + 7^t$ (D) $h^{-1}(t) = -19 + \log_7(t)$

(E) $h^{-1}(t) = \dfrac{1}{7^t + 19}$

Use the following story to answer questions 73 and 74.

The velocity of a skydiver, in feet per second, *t* seconds after jumping out of an airplane, is modeled by the function $v(t) = a\left(1 - e^{-bt}\right)$, where *a* and *b* are positive constants.

73. Based on this model, what happens to the skydiver's velocity as $t \to \infty$? The skydiver's velocity approaches:

(A) ∞ (B) $a+b$ (C) $a-b$ (D) a (E) b

74. Assume that $a = 100$. If the skydiver's velocity is 70 feet per second after 10 seconds, determine the exact value of b.

(A) $b = \dfrac{\ln(10)}{70}$ (B) $b = \dfrac{\ln(0.7)}{10}$ (C) $b = \dfrac{\ln(0.7)}{-10}$

(D) $b = \dfrac{\ln(0.3)}{10}$ (E) $b = \dfrac{\ln(0.3)}{-10}$

75. Simplify the expression completely: $\ln(4e^x)$

(A) $4x$ (B) $\ln(4)+x$ (C) $\ln(x)+4x$
(D) $x\ln(4)+x$ (E) $\ln(4)+e^x$

Use $f(x)=\log_7(11x+3)$ **to answer questions 76 and 77.**

76. Find the domain of $f(x)$.

(A) $\left[-\frac{3}{11},\infty\right)$ (B) $\left(-\frac{11}{3},\infty\right)$ (C) $(0,\infty)$
(D) $\left(-\frac{3}{11},\infty\right)$ (E) $\left(\frac{3}{11},\infty\right)$

77. Find the exact zero of $f(x)$.

(A) $x=-\frac{2}{11}$ (B) $x=-\frac{4}{11}$ (C) $x=\frac{10}{11}$
(D) $x=\log_7(3)$ (E) None of these

78. Solve for x: $\log_4(2x+1)-\log_4(x-3)=1$

(A) $x=-2$ only (B) $x=4$ or $x=\frac{7}{2}$ only (C) $x=\frac{11}{2}$ only

(D) $x=-4$ only (E) $x=\frac{13}{2}$ only

79. Let $f(x)=\log_3(9x)$ and $g(x)=3^x$. Find $f(g(x))$ and simplify.

(A) $2+x$ (B) $3+x$ (C) $9+x$
(D) $2x$ (E) $9x$

80. Solve for k: $11ke^{2k} + 9k^2e^{2k} = 0$.

(A) $k = 0$ only (B) $k = -\frac{11}{9}$ only (C) $k = 0, k = -\frac{11}{9}$ only

(D) $k = \ln(2)$ only (E) $k = 0, k = \ln(2), k = -\frac{11}{9}$ only

81. Let $f(x) = C \cdot b^x$. Determine the constants C and b so that $f(3) = 7$ and $f(4) = 35$.

(A) $C = \frac{125}{7}, b = 7$ (B) $C = \frac{7}{125}, b = 5$ (C) $C = \frac{7}{125}, b = 7$

(D) $C = 3, b = 35$ (D) $C = 7, b = 5$

Use the story to answer questions 81 and 82.

A population grows with an annual growth rate of 16.6% per year.

82. What is the population's continuous growth rate per year? Round to one decimal place.

(A) 16.6% (B) 2.8% (C) 18.1% (D) 15.4% (E) 14.6%

83. What is the population's annual growth factor?

(A) 16.6 (B) 1.66 (C) 1.166 (D) 0.154 (E) 1.536

84. Rewrite the following expression: $\log(x+2)-5\log(x^2+1)+3\log(x)$

(A) $\log\left(\dfrac{x^3(x+2)}{(x^2+1)^5}\right)$ (B) $\dfrac{\log(x+2)\log(x^3)}{\log(x^2+1)^5}$ (C) $\log\left(\dfrac{x+2}{x^3(x^2+1)^5}\right)$

(D) $\dfrac{\log(x^3(x+2))}{\log(x^2+1)^5}$ (E) $-15\log\left(\dfrac{x(x+2)}{(x^2+1)}\right)$

85. Which of the following functions have at least one horizontal asymptote?

(1) $f(x)=\arctan x$ (2) $f(x)=7\left(\dfrac{1}{5}\right)^x$ (3) $f(x)=5x^5+7x^2-1$

(4) $f(x)=\sqrt{x+7}$ (5) $f(x)=\dfrac{x^3}{x^2+5}$

(A) (4) and (5) only (B) (1), (2), and (5) only

(C) (3) and (4) only (D) (1) and (2) only

(E) (2) and (5) only

86. Each function below describes how something changes. Use the descriptions to determine which function(s) describe exponential growth or decay.

$f(t)$: The area of the circle doubles every 2 hours.
$g(t)$: The mass of the algae colony decreases by 2% each day.
$h(t)$: The volume of the sphere is proportional to its radius.

(A) $f(t)$ only (B) $g(t)$ only (C) $f(t)$ and $g(t)$ only

(D) $g(t)$ and $h(t)$ only (E) $f(t)$, $g(t)$ and $h(t)$

87. A video is posted on the internet. By 1:00 pm today, there were 2500 views. By 5:00 pm today, there were 6500 views. Express the number of views, V, as a function of the number of hours since 1:00 pm today if the number of views increases exponentially.

(A) $V(t) = 6500(2.6)^{(t-1)/4}$ (B) $V(t) = 2500(2.6)^{t}$ (C) $V(t) = 2500(2.6)^{t/4}$

(D) $V(t) = 2500(2.6)^{(t-1)/4}$ (E) $V(t) = 6500(2.6)^{-t/4}$

88. Suppose the number of "likes" for a particular Instagram page increases according to a model given by $V(t) = V_0 e^{0.08t}$, where V is measured in millions and t is measured in weeks.

How long will it take for the number of "likes" to triple?

(A) $\ln(37.5)$ weeks (B) $12.5\ln(3)$ weeks (C) $12.5\ln(3V_0)$ weeks

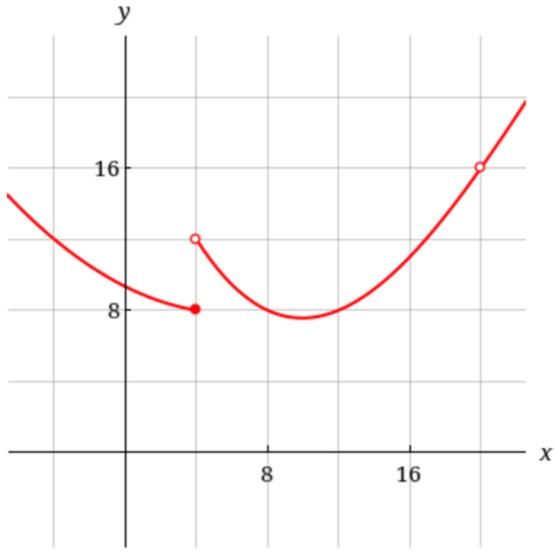
(D) $0.08\ln(3)$ weeks (E) $3\ln(1.08)$ weeks

89. Suppose $f(x) = \frac{x^2-4}{cx(2-x)}$. Determine the value of c so that $\lim_{x\to\infty} f(x) = 5$.

(A) c = 5 (B) c = –5 (C) c = 1/5

(D) c = –1/5 (E) c = 1

Use the graph of *g(x)* below to answer questions 90 and 91.



90. Evaluate $\lim_{x \to 4^-} f(x)$.

(A) 4 (B) 8 (C) 12 (D) 16 (E) DNE

91. Evaluate $\lim_{x \to 20} f(x)$.

(A) 8 (B) 12 (C) 16 (D) 20 (E) DNE

92. Suppose *g(t)* is an exponential function. All of the following statements **must** be true except for one. Which of the following statements could NOT be true?

(A) $g(t)$ has no vertical asymptote.

(B) $g(t)$ has a horizontal asymptote.

(C) $\lim_{t \to 0} g(t)$ exists (i.e. this limit is a real number)

(D) $\lim_{t \to -\infty} g(t) = \lim_{t \to \infty} g(t)$

(E) $g^{-1}(t)$ is a logarithmic function.