



Summer Review

for

Students Entering

APCalculus BC

AP Calculus BC Summer Packet

Please show all work in the spaces provided.
The answers are provided at the end of the packet.

Algebraic Manipulation

1. Evaluate $\frac{3x-y^2}{3(x-y)}$ if $x=5$ and $y=-3$

2. Simplify: $(x^{2y})(2x^y)(x^{y+3})$

3. $\frac{5x^{-3}y^2}{x^5y^{-1}z^0} \cdot \frac{(2xy^3)^{-2}}{xy}$

4. Simplify $\frac{18xy^3}{7a^2b^2} \div \frac{12x^2y}{35a^2b}$

5. Subtract $(-3g^2 + 2g - 9)$ from $(g^2 - 4g - 6)$

6. Expand $(3x^4 - 7y^3)^2$

7. Multiply

$$(x^2 + x - 3)(3x^2 - x + 3)$$

8. Expand using Pascal's Triangle

$$(3x - 2)^5$$

Name: _____

ID: A

9. Factor completely

a) $a^2 - 6a - 40$

b) $6y^2 + 13y - 5$

c) $12m^3n - 75mn$

d) $49x^2 - 100y^2$

e) $6xp + 42x - 5yp - 35y$

10. Factor completely

a) $-5x^4y^2 + 20xy^3 + 15xy^4$

b) $3x^3 + x^2 - 15x - 5$

c) $20x^2 - 125y^2$

d) $4x^2 - 12xy + 9y^2$

e) $x^2 - 6x + 9 - 4y^2$

Name: _____

ID: A

11. Factor the expression completely.

$$125a^3 - 8b^6$$

12. Factor the expression completely.

$$4(x^2 + 5)^4 (3x)(x-1)^4 + (x^2 + 5)^5 (9)(x-1)^3$$

13. Factor the expression completely.

$$(x^2 + 4)^{\frac{1}{2}} + 2(x^2 + 4)^{-\frac{1}{2}}$$

14. Divide using synthetic division

$$(3x^5 + 5x^4 + x + 5) \div (x + 2)$$

15. Divide: $(x^5 + x^4 - 8x^3 + x + 2) \div (x^2 + x - 7)$

16. Simplify $\frac{a^2 - x^2}{a^2} \cdot \frac{a}{3x - 3a}$

17. Simplify.

$$\frac{(4w^2 - 3wy)(w + y)}{(3y - 4w)(5w^2 - y^2)}$$

18. Simplify $\frac{x^3 - 64}{x^3 + 64} \div \frac{x^2 - 16}{x^2 - 4x + 16}$

19. Simplify.

$$\frac{1 + \frac{1}{x}}{1 - \frac{x}{y}}$$

20. Simplify the compound fractional expression.

$$\frac{\frac{5}{x-1} - \frac{4}{x+1}}{\frac{x}{x-1} + \frac{1}{x+1}}$$

21. Simplify.

$$\frac{5}{6x - 18} - \frac{x - 1}{4x^2 - 14x + 6}$$

22. Perform the subtraction and simplify.

$$\frac{x}{x^2 - x - 20} - \frac{1}{x + 4} - \frac{3}{x - 5}$$

Name: _____

ID: A

23. Simplify

a) $-3\sqrt[3]{-3} + 2\sqrt[3]{162} + 3\sqrt[3]{81}$

b) $4\sqrt{15}(4-3\sqrt{5})$

c) $(\sqrt{3} + \sqrt{5x})(\sqrt{3} - \sqrt{5x})$

d) $2m^2 \cdot 4m^{\frac{3}{2}} \cdot 4m^{-2}$

e) $\left(3p^{\frac{3}{2}}\right)^{-2}$

f) $\left(\frac{x^{\frac{1}{2}}y^{-2}}{yx^{\frac{-7}{4}}}\right)^4$

g) $\frac{\left(x^{\frac{1}{2}}y^2\right)^{\frac{-5}{4}}}{x^2y^{\frac{1}{2}}}$

24. Evaluate without a calculator:

a) $\left(-\frac{1}{2}\right)^{-4}$

b) $-32^{\frac{3}{5}}$

c) $27^{-\frac{5}{3}}$

d) $.0049^{\frac{3}{2}}$

25. Simplify

a) $\sqrt[5]{243a^{20}b^{25}}$

b) $2\sqrt[3]{18a^2b} \cdot 3\sqrt[3]{12ab^5}$

26. Rationalize the denominator and simplify

a) $\frac{2a}{\sqrt[3]{b}}$

b) $\frac{\sqrt[4]{5}}{4\sqrt[4]{27}}$

c) $\frac{\sqrt{3}}{\sqrt{5}-\sqrt{6}}$

d) $\frac{x}{\frac{2}{y^5}}$

27. Rationalize the numerator and simplify

a) $\frac{\sqrt{3}+\sqrt{7}}{4}$

b) $\frac{\sqrt{x+3}-5}{3x-66}$

28. Simplify and rewrite using only positive exponents.

$$\frac{\sqrt{4x-16}}{\sqrt[4]{(x-4)^3}}$$

29. Simplify the expression

$$-4 \left(\frac{2x-1}{2x+1} \right)^{-3} \left[\frac{2(2x+1)-2(2x-1)}{(2x+1)^2} \right]$$

30.
$$\left(\frac{16}{x^{-2}} - \frac{40}{x^{-1}y^{-1}} + \frac{25}{y^{-2}} \right)^{\frac{-1}{2}}$$

31. Simplify each expression and write the result in the form $a + bi$.

a) $6 - (2 + 9i) + (-1 + 4i)$

b) $(7 - i)(3 + 3i)$

c) $(5 - 7i)^2$

d) $\frac{3 - i}{2 + 3i}$

e) $\frac{-5 - 3i}{-4i}$

f) i^{1795}

32. Use the Laws of Logarithms to expand the expression.

$$\ln \left(\frac{x^4 \sqrt{x-1}}{2x+3} \right)$$

33. Use the Laws of Logarithms to combine the expression.

$$5 \log x - \frac{1}{3} \log(x^2 + 1) + 4 \log(x - 1)$$

34. Evaluate the expression.

$$10^{\log x}$$

35. Evaluate the expression.

$$\log_4 64^{600}$$

36. Evaluate the expression.

$$\frac{1}{\ln \left(\frac{1}{\sqrt[4]{e^7}} \right)}$$

37. Evaluate the expression.

$$\log(0.000001)$$

Equations and Inequalities

38. Solve $3(x+2) = \frac{1}{4}(12x+4) - 5x$

39. Solve the equation.

$$\frac{2}{5}y + \frac{1}{2}(y-4) = \frac{y+1}{4}$$

40. Solve. $\frac{4}{x+3} + \frac{5}{6} = \frac{23}{18}$

41. Solve the equation.

$$|3x-5|=7$$

42. Solve the equation for the indicated variable:

a) $\frac{ax+b}{cx+d} = 11$, solve for x .

b) $\frac{x}{a} = c - \frac{x}{b}$, solve for x .

c) $\frac{x}{a} = c - \frac{x}{b}$, solve for b .

Name: _____

ID: A

43. Solve each equation:

a) $n(9 - 3n)(2n + 5) = 0$

b) $x^2 + 8x - 20 = 0$

c) $20x(x - 1) = 42 - 9x$

d) $-8x^2 + 46x - 30 = 0$

e) $3x^2 - 6x = 10$

44. Solve by completing the square.

$$x^2 + 8x + 22 = 0$$

45. Solve the equation by completing the square.

$$2x^2 - 12x - 7 = 0$$

46. Solve by using the Quadratic Formula.

$$x^2 - 6x = -10$$

Name: _____

ID: A

47. Find all solutions of the equation and express them in the form $a + bi$.

$$25x^2 + 16 = 0$$

48. Find all real solutions of the equation.

$$x^6 - 9x^3 - 10 = 0$$

49. Solve

$$4x^{\frac{4}{3}} - 37x^{\frac{2}{3}} + 9 = 0$$

50. Solve $2(6x-3)^{\frac{1}{3}} - 4 = 0$

51. Solve $\frac{1}{x^2} - \frac{1}{x} = 6$

52. Solve
a) $\sqrt{x+2} + 4 = 7$

b) $2 = \sqrt{3b-2} - \sqrt{10-b}$

Name: _____

ID: A

53. Solve for x.

$$4^{3x} = 32^{x-1}$$

54. Solve for x.

$$4^{3x+2} = 3^{5x-4}$$

55. Use the definition of the logarithmic function to find x.

a) $\log_x 4 = \frac{1}{2}$

b) $\log_x 6 = \frac{1}{3}$

56. Solve for x: $\log_2(x^2 - 6x) = 4$

57. Solve for x.

$$\frac{27}{1 + e^{-x}} = 2$$

58. Solve the equation for x

$$e^{4x} + 2e^{2x} - 8 = 0$$

59. Solve for x.

$$2 - \ln(7 - x) = 0$$

60. Solve for x

$$\ln(1) - 4x^2 = \ln\left(\frac{1}{e}\right)$$

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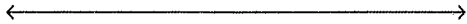
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61. Solve the inequality. Graph the solution on a number line.

$$|3x + 9| \geq 6$$



62. Solve and graph your answer on a real number line: $|x - 3| - 2 < 6$



63. Solve the nonlinear inequality. Express the solution using interval notation and graph the solution set.

$$x^2 + 3x > 10$$

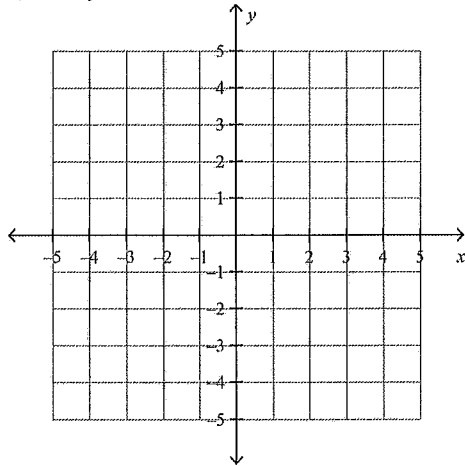
64. Solve the nonlinear inequality. Express the solution using interval notation and graph the solution set.

$$\frac{x}{3} - \frac{1}{x-2} \leq \frac{x+1}{4}$$

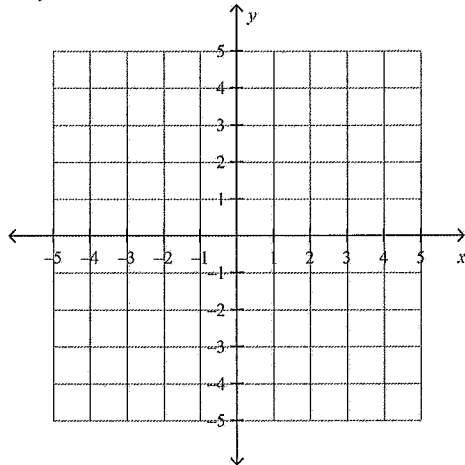
Lines and Coordinate Geometry

65. Graph the line of each equation:

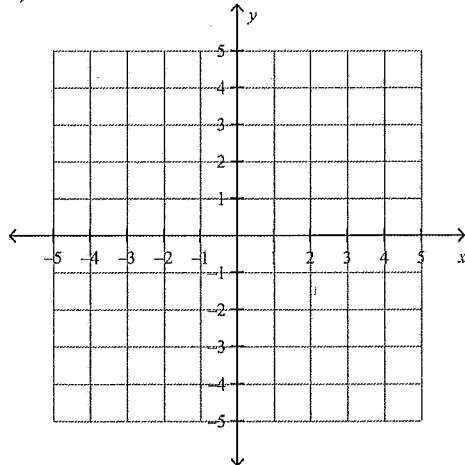
a) $x + 3y = 6$



b) $y = -2x + 4$



c) $x = 3$



66. Find the slope of:

a) a line passing through $(-4, 4)$ and $(2, -5)$

b) a line parallel to $y = 2x + 7$

c) the line whose equation is $2x - 3y = 12$

d) the line whose equation is $y = -5$

e) a line perpendicular to $6x + 5y = 9$

67. Determine whether the lines are parallel, perpendicular, or neither. Explain your reasoning.

$2x + 3y = 12$

$3x + 2y = 24$

Name: _____

ID: A

68. Find an equation, in point-slope form, of the line that satisfies the given conditions.

Through $(-1, -11)$; perpendicular to the line passing through $(3, 1)$ and $(7, -1)$.

Then, rewrite the equation in standard form.

69. Solve the system of equations by substitution

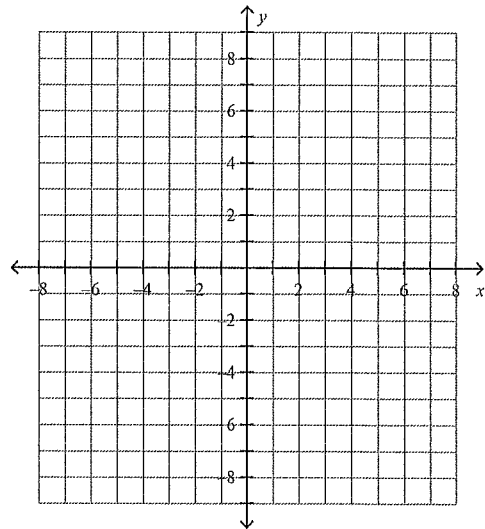
$$8x - 2y = 10$$

$$3x - y = 9$$

70. Solve the system of equations by graphing.

$$2x + 3y = -27$$

$$11x - 3y = -12$$



71. Solve the system of equations by elimination

$$2x - 3y = 6$$

$$9y - 6x = 9$$

Name: _____

ID: A

72. Solve the system of equations by any method.

$$0.6x + 1.6y = 2.8$$

$$-0.05x + 0.08y = -0.02$$

73. Solve the system of equations by any method.

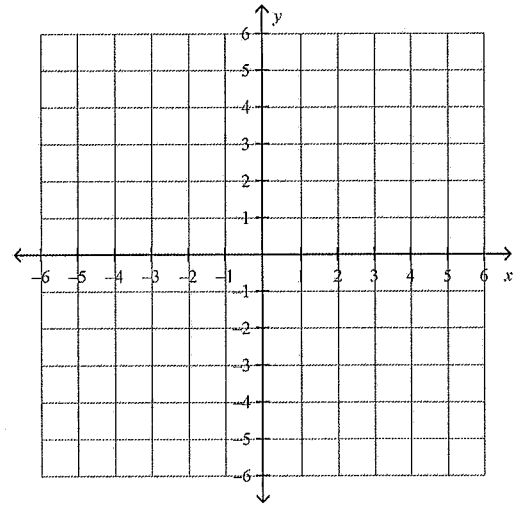
$$\frac{2}{3}x + \frac{5}{6}y = \frac{1}{4}$$

$$\frac{1}{5}x - \frac{1}{10}y = \frac{-1}{10}$$

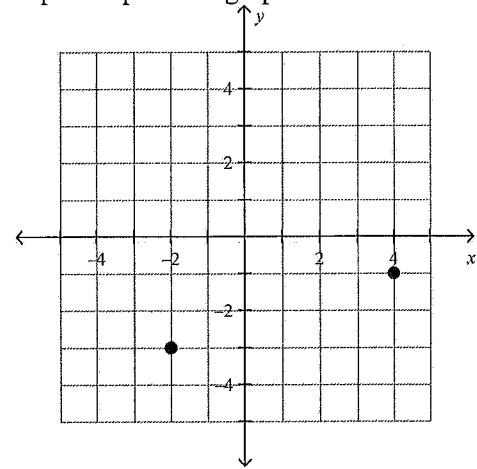
74. Find the solution set for the following system of inequalities.

$$x + 2y \leq -4$$

$$3x - 2y > -4$$



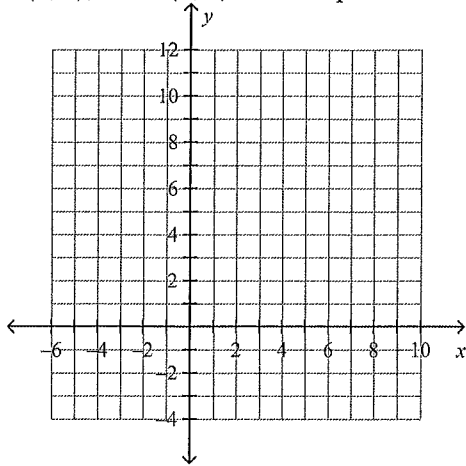
75. A pair of points is graphed.



(a) Find the distance between them.

(b) Find the coordinates of the midpoint.

76. Prove whether or not the points A(4, 3), B(2, 6), C(7, 5), and D(5, 8) form a square.

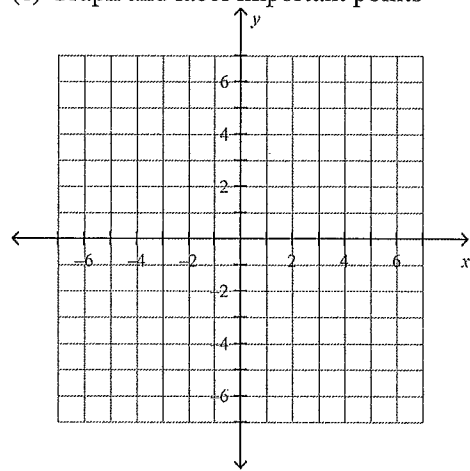


77. Find all points of intersection of the graphs of $x^2 + 3x - y = 3$ and $x + y = 2$.

78. Find the center and radius of the circle.

$$x^2 + y^2 - 6x + 4y - 3 = 0$$

- (a) The center is
 (b) The radius is
 (c) Graph and label important points



- (d) Domain:

Range:

79. If the point $(-1, 1)$ lies on the graph of the equation $kx^2 - xy + y^2 = 5$, find the value of k .

Functions

80. If $f(x) = -2x^2 + x + 3$, evaluate each of the following:

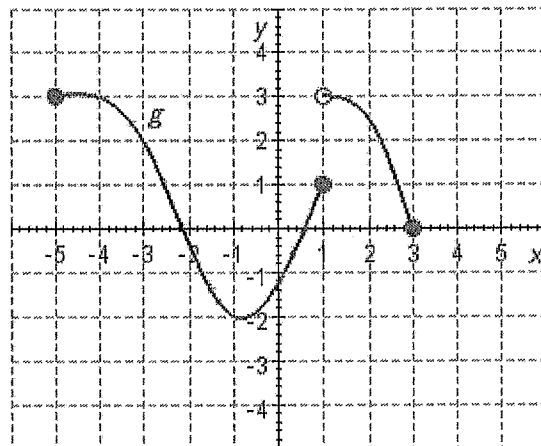
a) $f(-2)$

b) $f(3m)$

c) $f(p^5)$

d) $f(x+h)$

81. The graph of a function g is given.



(a) Find $g(-5)$. _____

(b) Find $g(-3)$. _____

(c) Find $g(-1)$. _____

(d) Find $g(1)$. _____

(e) Find $g(3)$. _____

(f) Find the domain of g . _____

(g) Find the range of g . _____

(h) Estimate the values of x for which is $g(x) = -1$

82. Consider the following function:

$$f(x) = 3x^2 - 12x + 7$$

a) Write the quadratic function in vertex form.

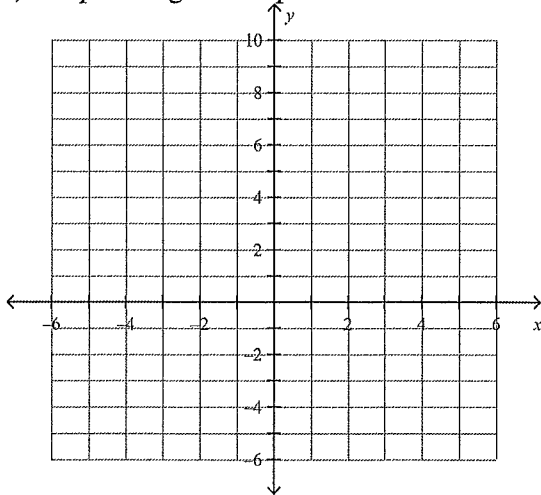
b) State the vertex and whether the graph has a minimum or maximum.

c) State the equation of the axis of symmetry.

d) Find the x intercepts and approximate the values.

e) Find the y intercept

f) Graph using all the points.



83. Consider the following function:

$$f(x) = -2x^2 - 12x - 14$$

a) Write the quadratic function in vertex form.

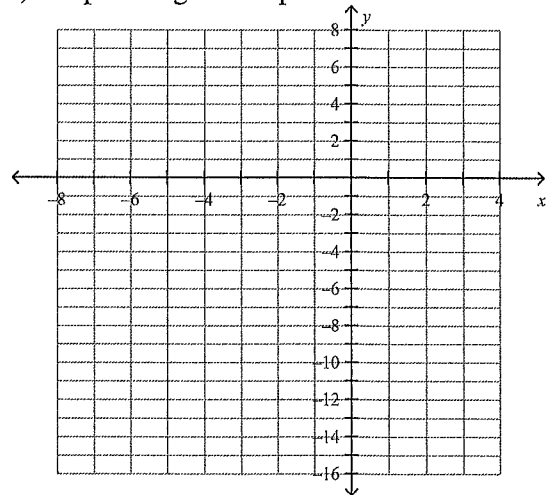
b) State the vertex and whether the graph has a minimum or maximum.

c) State the equation of the axis of symmetry.

d) Find the x intercepts and approximate the values.

e) Find the y intercept

f) Graph using all the points.



Name: _____

ID: A

84. Find the domain of the function.

$$h(x) = \sqrt{8x-7}$$

85. Find the domain of the function.

$$f(x) = \frac{x+9}{x^2-4}$$

86. Find the domain of the function.

$$g(x) = \sqrt{x^2-4x-32}$$

87. Find the domain of the function.

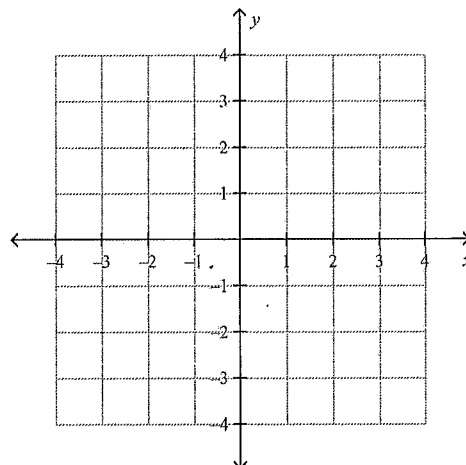
$$g(x) = \ln(3-2x) - \sqrt{7x+2}$$

88. Explain how the graph of g is obtained from the graph of f .

$$g(x) = -\frac{1}{2}f(x-5)$$

89. Sketch the graph of the function using transformations.

$$f(x) = -\sqrt{x+2} + 3$$



State the domain and range.

90. Determine whether $f(x) = \frac{x}{x^2+4}$ is even, odd, or neither

91. Evaluate the piecewise defined function at the indicated values.

$$f(x) = \begin{cases} x^2 + 4x & \text{if } x \leq -3 \\ x & \text{if } -3 < x \leq 1 \\ -9 & \text{if } x > 1 \end{cases}$$

(a) Evaluate $f(-4)$.

(b) Evaluate $f\left(-\frac{7}{2}\right)$.

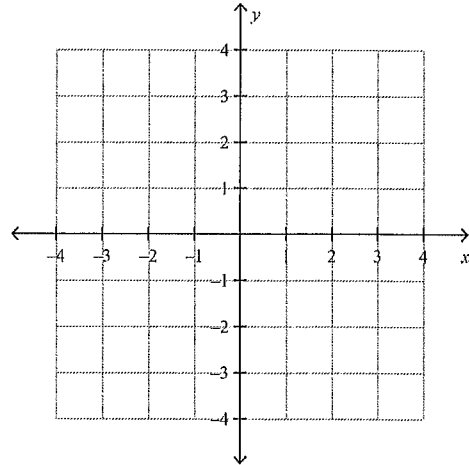
(c) Evaluate $f(-3)$.

(d) Evaluate $f(0)$.

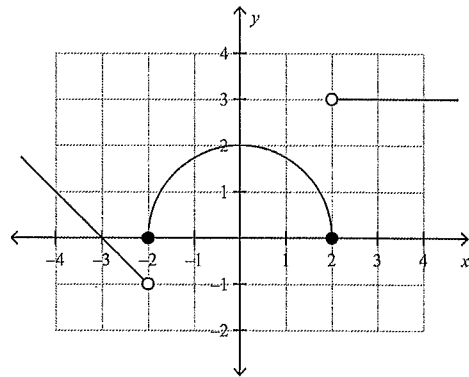
(e) Evaluate $f(35)$.

92. Sketch the graph of the piecewise defined function.

$$f(x) = \begin{cases} 1 & \text{if } x < -1 \\ x^2 & \text{if } -1 \leq x \leq 1 \\ -x + 3 & \text{if } x > 1 \end{cases}$$



93. Write the equation of the piecewise defined function shown below:



Name: _____

ID: A

94. Write the following absolute value functions as piecewise functions without absolute value.

a) $f(x) = |2x - 4|$

b) $g(x) = |6 - 2x| - 3$

c) $h(x) = |4x + 1| + 2x - 3$

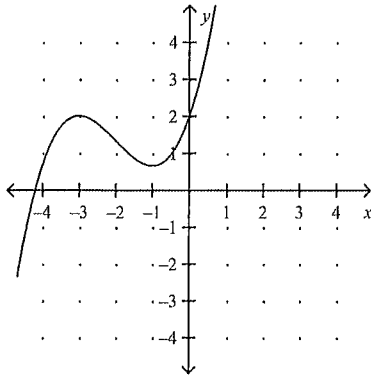
95. Write the following absolute value functions as piecewise functions without absolute value.

a) $f(x) = |x^2 - 9|$

b) $g(x) = |x^2 + x - 12|$

c) $h(x) = |x^2 + 4x + 4|$

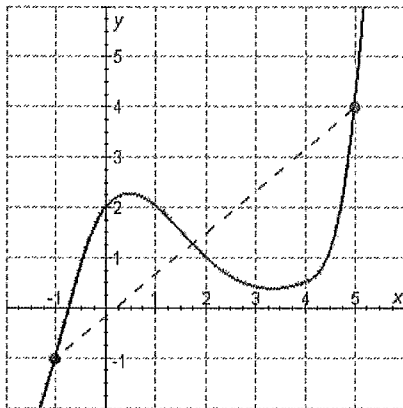
96. The graph of a function is sketched below.



a) Determine the intervals on which the function is decreasing and which it is increasing.

b) State the relative minimum and maximum values.

97. The graph of a function is given. Determine the average rate of change of the function between the indicated values of the variable.



98. Determine the average rate of change of the function between the indicated values of the variable.

$$f(x) = 10 - 6x + x^2$$

a) $x = -1, \quad x = 3$

a) $x = a, \quad x = a + h$

99. Explain what the difference quotient represents in terms of the graph of the function.

Name: _____

ID: A

100. Evaluate the difference quotient for each function.

a) $f(x) = \sqrt{x+3}$

b) $g(x) = x^3 - 4x$

c) $g(x) = \frac{3}{x+5}$

101. Given $f(x) = \sqrt[5]{4-9x}$ and $g(x) = x^5 - 6$, evaluate $(f \circ g)(x)$ and $(g \circ f)(x)$ and simplify as much as possible.

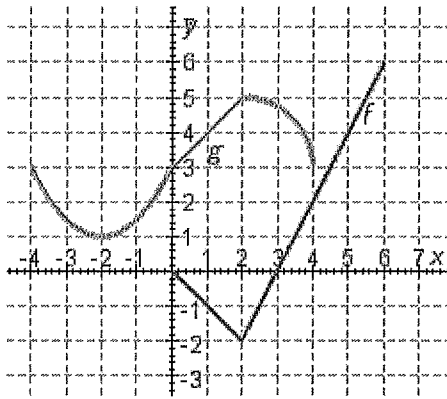
102. Find $f \circ g \circ h$.

$$f(x) = \frac{5}{x}, g(x) = x^3, h(x) = x^2 + 4$$

Name: _____

ID: A

103. Use the given graphs of f and g to evaluate the expression.



$(g \circ f)(3) = \underline{\hspace{2cm}}$

104. Find the inverse function of f .

$$f(x) = (8 - x^3)^5$$

105. Find the inverse function of f .

$$f(x) = \frac{5x - 3}{2x + 7}$$

106. Factor the function completely and then find all zeros of $f(x) = 2x^3 - 3x^2 - 8x + 3$.

107. Find a polynomial with integer coefficients that satisfies the given conditions.

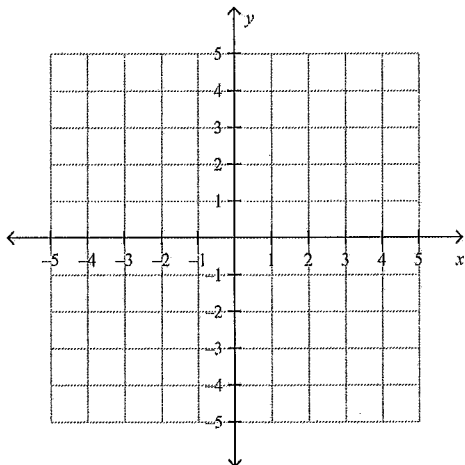
Q has degree 4, and zeros 3, 0, and $7i$

108. Find all vertical and horizontal asymptotes of

$$f(x) = \frac{6x^3 - 24x}{2x^3 - 6x^2 - 8x}$$

109. Sketch the graph of the function using transformations.

$$f(x) = -\ln(x+4) - 1$$



Domain:

Range:

Equation of Asymptote:

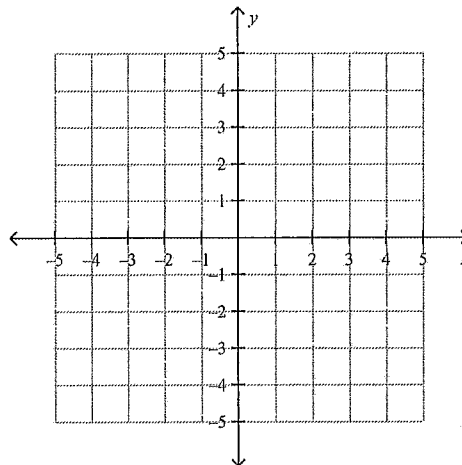
Calculate the x and y intercepts

110. Let $f(x) = \sqrt[3]{x+2}$ and $g(x) = x^3 - 2$. Which of the following are true?

- a) $g(x) = f^{-1}(x)$ for all real values of x .
- b) $(f \circ g)(x) = 1$ for all real values of x .
- c) $f(x)$ is one to one.

111. Sketch the graph of the function using transformations.

$$f(x) = e^{-x} - 2$$



Domain:

Range:

Equation of Asymptote:

Calculate the x and y intercepts

112. Which of the following are true?

- a) $\ln(x+y) = \ln(x) + \ln(y)$
- b) $\ln(x^y) = y \ln(x)$
- c) $\ln(x)^y = y \ln(x)$
- d) $\frac{\ln x}{\ln y} = \log_y x$
- e) $\frac{\ln x}{\ln y} = \ln(x-y)$

Trigonometry

113. Which of the following expressions are equivalent?

- a) $\cos^2 x$ b) $\cos x^2$ c) $(\cos x)^2$

114. Which of the following expressions are equivalent?

- a) $(\sin x)^{-1}$ b) $\arcsin x$ c) $\sin x^{-1}$

- d) $\frac{1}{\sin x}$ e) $\csc x$ f) $\sin^{-1} x$

115. Find the terminal point $P(x,y)$ on the unit circle

determined by the given value of $t = \frac{14\pi}{3}$.

116. Convert 150° to radians.

117. Convert $-\frac{3\pi}{4}$ radians to degrees.

118. Find an angle between 0 and 2π that is coterminal with the given angle.

$$\frac{19\pi}{4}$$

119. Find the reference angle for the given angle.

a) 120°

b) 225°

c) 1110°

d) $\frac{35\pi}{3}$

d) $\frac{28\pi}{5}$

Name: _____

ID: A

120. Find the exact value for each trigonometric function.

(a) $\sec \frac{23\pi}{6}$

(b) $\csc \frac{7\pi}{6}$

(c) $\cot \left(-\frac{\pi}{3} \right)$

(d) $\tan \left(-\frac{9\pi}{2} \right)$

(e) $\sec(-4\pi)$

121. Evaluate the expression without using a calculator.

$$\sin 45^\circ \cos 60^\circ + \sin 60^\circ \cos 45^\circ$$

122. Find the values of the trigonometric functions of θ from the information given.

$$\tan \theta = 6, \sin \theta > 0$$

(a) $\sin \theta$

(b) $\cos \theta$

(c) $\csc \theta$

(d) $\sec \theta$

(e) $\cot \theta$

123. Simplify completely the trigonometric expression.

$$\frac{\cos x}{\sec x + \tan x}$$

Name: _____

ID: A

124. Use the addition and subtraction formulas to simplify the expression.

$$\frac{\cos(x+y)}{\cos x \cos y}$$

125. Use an appropriate half-angle formula to find the exact value of the expression.

$$\sin 15^\circ$$

126. Use the double angle identity to rewrite the expression

$$\sin 6x$$

127. Evaluate in radians

a) $\arccos\left(\frac{-\sqrt{3}}{2}\right)$

b) $\arctan(-1)$

c) $\sin^{-1}\left(-\frac{1}{2}\right)$

d) $\sec^{-1}\left(-\frac{1}{2}\right)$

e) $\arcsin(-1)$

128. Evaluate the expression by sketching a triangle.

$$\sec\left(\sin^{-1}\frac{12}{13}\right)$$

129. Rewrite as an algebraic expression by sketching a triangle.

$$\cot\left(\sin^{-1}\frac{x}{7}\right)$$

Name: _____

ID: A

130. Find all solutions of the equation.

$$4\cos^2 x - 4\cos x + 1 = 0$$

131. Find all solutions of the equation.

$$1 - \sin x = 2\cos^2 x$$

132. Find all solutions of the equation.

$$\tan^2(5x) - 1 = 0$$

133. Solve the inequality

$$2\sin^2 x \geq \sin x \quad \text{over} \quad 0 \leq x < 2\pi$$

134. Given that $\tan \theta = \frac{2}{5}$, and θ is in the third quadrant, find the values of:

a) $\sec \theta$

b) $\sin(2\theta)$

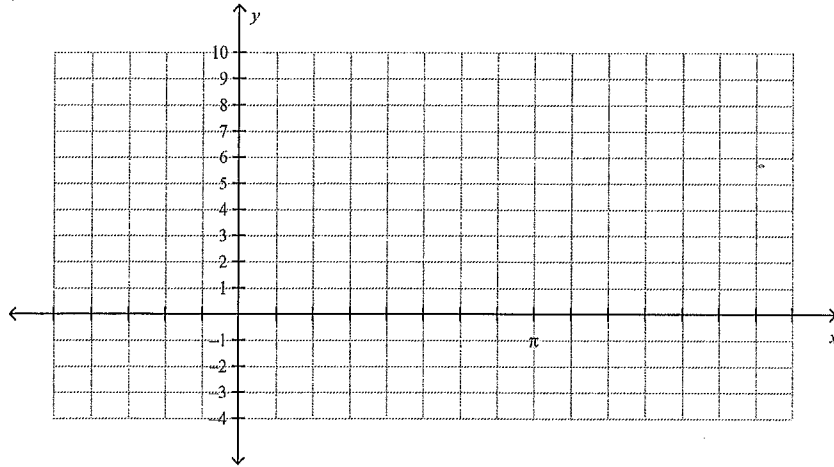
c) $\tan\left(\frac{\theta}{2}\right)$

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ID: A

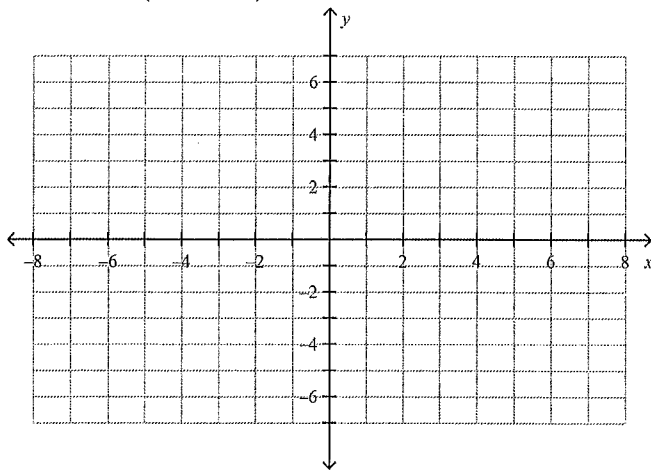
135. Graph the function and state the amplitude, period, domain, and range. Label the values on the x -axis clearly.

$$g(x) = -3 \sin(2x) + 4$$



136. Graph one period of the function and state the period, domain, and range.

$$g(x) = 3 \tan\left(\frac{\pi}{4}x - \frac{\pi}{2}\right)$$



Name: _____

ID: A

Problem Solving

You must use an ALGEBRAIC process for all of the word problems.

Correct answers obtained by guess-and-check will not obtain full credit.

137. Find four consecutive odd integers whose sum is 464.

139. An orange has 15 calories more than a grapefruit. Twenty oranges and ten grapefruits have 1800 calories together. Jim ate three oranges and half a grapefruit. How many calories did Jim eat?

138. The product of 3 and a number, decreased by 8, is the same as twice the number, increased by 15. Find the number.

140. A sports club publishes a monthly newsletter. Expenses are \$0.90 for printing and mailing a copy, plus \$600 total for research and writing. Write a function that represents the total monthly cost of publishing the newsletter and use it to determine the cost of sending 1000 copies.

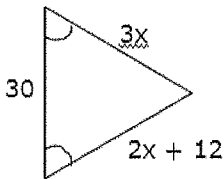
Name: _____

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141. A company manufactures and sells small weather radios. If the cost of producing the radio can be expressed as $C(x) = 10,000 + 30x$ and the revenue produced from the sales can be expressed as $R(x) = 50x$, how many radios must be produced and sold for the company to make a profit? (If you don't know the meaning of a term, look it up!)

142. Five times the supplement of an angle is 630° more than its complement. Find the angle, its supplement, and its complement.

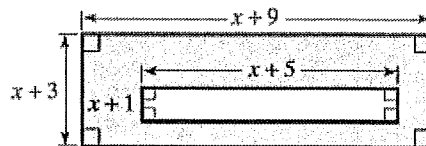
143. Find the value of x . Then, find the perimeter of the triangle.



144. Find the area and perimeter of a right triangle with a leg of length 8 and hypotenuse 12.

145. The area of a triangle is 72 in^2 and the base is 8 in. Find the height.

146. In the figure below, find a polynomial expression that represents the area of the shaded region.

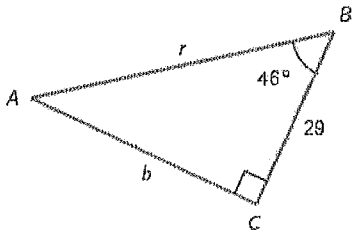


Name: _____

ID: A

147. Phyllis invested \$13,000, a portion earning a simple interest rate of $4\frac{1}{2}\%$ per year and the rest earning a rate of 4% per year. After one year the total interest earned on these investments was \$555. How much money did she invest at each rate?

148. Solve the right triangle.

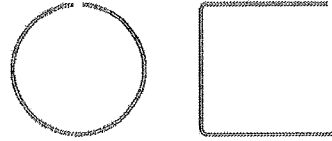


(a) Find b . Please give the answer to two decimal places.

(b) Find r . Please give the answer to two decimal places.

(c) Find $m\angle A$.

149. A wire 230 in. long is cut into two pieces. One piece is formed into a square and the other into a circle. If the two figures have the same area, what are the lengths of the two pieces of wire (to the nearest tenth of an inch)?



_____ in.

150. A cylindrical can has a volume of $90\pi \text{ cm}^3$ and is 10 cm tall.



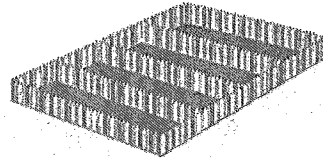
a) What is its diameter?

b) If the can has a bottom, but no top, what is its surface area?

151. A poster is 12 inches longer than it is wide. Find a function that models its area A in terms of its width w .

152. The volume of a cone is 80 in^3 . Find a function that models the height h of the cone in terms of its radius r .

153. A rancher with 650 ft of fencing wants to enclose a rectangular area and then divide it into four pens with fencing parallel to one side of the rectangle (see the figure).



(a) Find a function that models the total area of the four pens.

(b) Find the largest possible total area of the four pens.

Calculus AB Review

154. $\lim_{x \rightarrow 25} \frac{\sqrt{x} - 5}{x - 25}$

155. $\lim_{x \rightarrow -2} \frac{x^3 - 8}{x^3 + 2x^2 - 9x - 18}$

156. $\lim_{x \rightarrow 6} \frac{x - 6}{|x - 6|}$ (Hint: draw the graph)

157. If $f(x) = \begin{cases} 3 - x & \text{if } x \neq 1 \\ 7 & \text{if } x = 1 \end{cases}$, find $\lim_{x \rightarrow 1} f(x)$

158. If $\lim_{x \rightarrow c} f(x) = \frac{-1}{2}$ and $\lim_{x \rightarrow c} g(x) = \frac{2}{3}$, find $\lim_{x \rightarrow c} \frac{f(x)}{g(x)}$.

159. $\lim_{x \rightarrow 0} \frac{\sqrt{x+4} - 2}{x}$

160. $\lim_{x \rightarrow 2} \sec\left(\frac{\pi x}{3}\right)$

161. $\lim_{x \rightarrow 0} \frac{x}{\tan x}$

162. $\lim_{x \rightarrow 0} \left(2 + \frac{5}{x^2}\right)$

163. $\lim_{x \rightarrow \infty} \frac{x^2 - x - 6}{5x^2}$

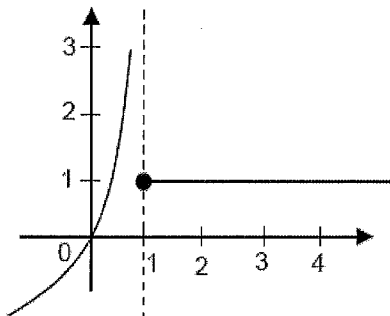
$$164. f(x) = \begin{cases} -x^2 & \text{if } x < 1 \\ 2 & \text{if } x = 1 \\ x-2 & \text{if } x > 1 \end{cases}$$

Find

a) $\lim_{x \rightarrow 1^-} f(x)$ b) $\lim_{x \rightarrow 1^+} f(x)$ c) $\lim_{x \rightarrow 1} f(x)$

d) $f(1)$ e) Is $f(x)$ continuous at $x = 1$? Why?

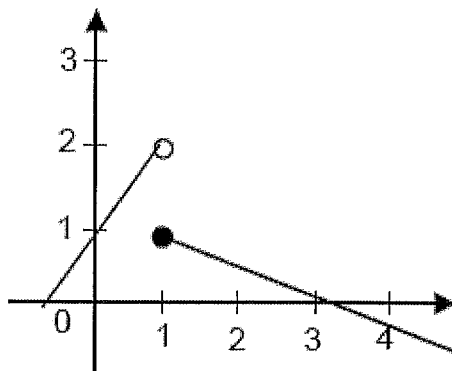
165. The graph of $f(x)$ is shown below.



a) $\lim_{x \rightarrow 1^-} f(x)$ b) $\lim_{x \rightarrow 1^+} f(x)$ c) $\lim_{x \rightarrow 1} f(x)$

d) $f(1)$ e) Is $f(x)$ continuous at $x = 1$? Why?

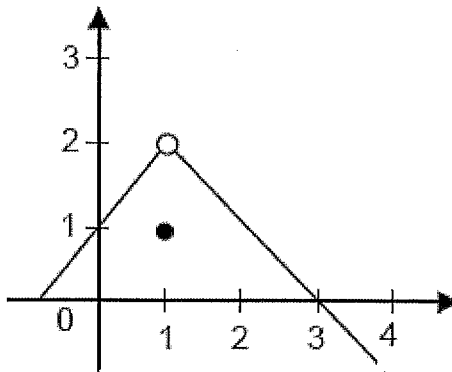
166. The graph of $f(x)$ is shown below.



a) $\lim_{x \rightarrow 1^-} f(x)$ b) $\lim_{x \rightarrow 1^+} f(x)$ c) $\lim_{x \rightarrow 1} f(x)$

d) $f(1)$ e) Is $f(x)$ continuous at $x = 1$? Why?

167. The graph of $f(x)$ is shown below.



a) $\lim_{x \rightarrow 1^-} f(x)$ b) $\lim_{x \rightarrow 1^+} f(x)$ c) $\lim_{x \rightarrow 1} f(x)$

d) $f(1)$ e) Is $f(x)$ continuous at $x = 1$? Why?

168. At which values of x is $f(x)$ is $f(x) = \frac{x^2 - 2x - 3}{x^2 - 5x + 6}$ discontinuous? Show support using the definition of continuity and state whether the discontinuity is removable or non-removable.

169. What value must c have so that $f(x)$ is continuous over all real numbers?

$$f(x) = \begin{cases} x-2 & \text{if } x \leq 5 \\ cx-3 & \text{if } x > 5 \end{cases}$$

170. Find all holes, vertical and horizontal asymptotes of $g(x) = \frac{x+1}{x^2-1}$.

171. Find the derivative of $f(x) = \sqrt[5]{x^3} + \frac{4}{x^7} + e^8$

172. Find $\frac{d}{dx} \left[\frac{\cos(2x^3)}{3x^4} \right]$

173. Find the derivative of $y = \tan(5\sqrt{x})$.

174. Find the derivative of $f(x) = \sqrt[4]{2x^3 - 5x}$.

Name: _____

ID: A

175. Find the derivative of $f(x) = e^{5x} \cos 7x$.

176. Find the derivative of $g(x) = x^{\frac{3}{2}} \ln x$.

177. Find the derivative of $h(x) = \sin x \cos x$

178. Evaluate $\int_1^{e^2} \frac{1}{x} dx$

179. Evaluate $\int_0^9 \frac{1}{\sqrt{x}} dx$

180. Evaluate $\int_0^\pi (2 + \sin \theta) d\theta$

181. Evaluate $\int \frac{1+x}{x} dx$

182. Evaluate $\int e^{3y} dy$

183. Evaluate $\int \cos x \sqrt{\sin x} dx$

184. Evaluate $\int \frac{t^2}{t^3 + 1} dt$

Name: _____

ID: A

185. Evaluate $\int_1^{\sqrt{e}} \frac{\ln y}{y} dy$

186. $\int \frac{e^x}{1+e^x} dx$

187. $\int 4 \csc x \cot x dx$

188. $\int \frac{3}{\sqrt{1-4x}} dx$

189. $\int 3x \csc^2(x^2) dx$

190. $\int 5 \tan(10x) dx$

191. Evaluate $\int \frac{4}{2x-3} dx$

192. Evaluate $\int_1^4 \frac{1}{4x^2+4x+1} dx$

193. $\int_{\frac{\pi}{2}}^{\frac{3\pi}{4}} 2 \cos x dx$

194. Find the average value of $f(x) = 3x^2 + 5$ on the interval $[0,4]$.

195. $f(x) = \int_2^{4x^2} \frac{1}{(t+1)^3} dt$

a) Find $f'(x)$

b) Find the equation of the tangent line to $f(x)$ at $x = 1$.

196. Find $\frac{dy}{dx}$ if $y = x^5 \cdot 5^x$

197. Find $\frac{dy}{dx}$ if $y = \ln \sqrt{2x^3 - 6}$

198. Find the slope of the tangent line to the graph of $y = (6 \ln x)e^x$ at $x = 4$.

199. Find the particular solution of the equation

$$f'(x) = 8x^{\frac{1}{3}} \text{ given that } f(1) = 10.$$

200. Find $f(x)$ given that $f''(x) = 4x + 1$ and $f'(1) = 4$ and $f(0) = 3$.

201. An object travels with a constant acceleration of 10 ft/s^2 . If $v(1) = 8 \text{ ft/s}$ and $s(2) = 20 \text{ ft}$, find the position function $s(t)$ describing the motion of this object.

Name: _____

ID: A

202. Find the specific solution $y = f(x)$ to the differential equation $y' \cdot y - 4x = 3$ given that $y(1) = -6$.

203. Suppose $\int_2^8 f(x)dx = 5$ and $\int_5^8 f(x)dx = -3$.

Find $\int_2^5 f(x)dx$.

204. Consider the data for $f(x)$

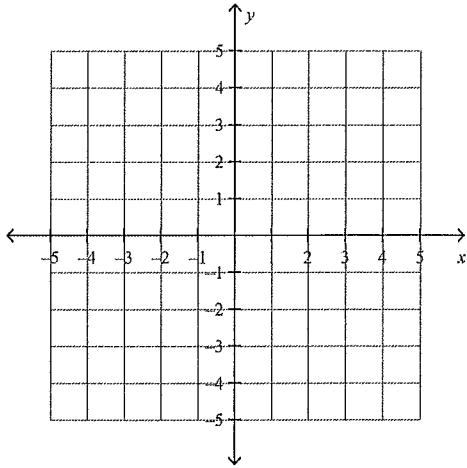
x	2	3	5	9	10
$f(x)$	5	8	7	11	13

a) Approximate $\int_2^{10} f(x)dx$ using a left Riemann sum and 4 sub-intervals indicated by the data.

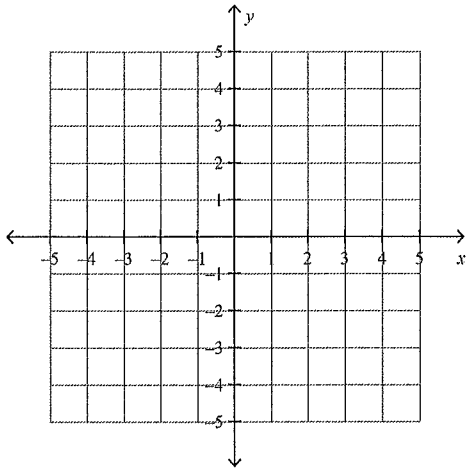
b) Approximate $\int_3^{10} f(x)dx$ using a trapezoidal sum with 3 sub-intervals indicated by the data.

c) Approximate $f'(4)$.

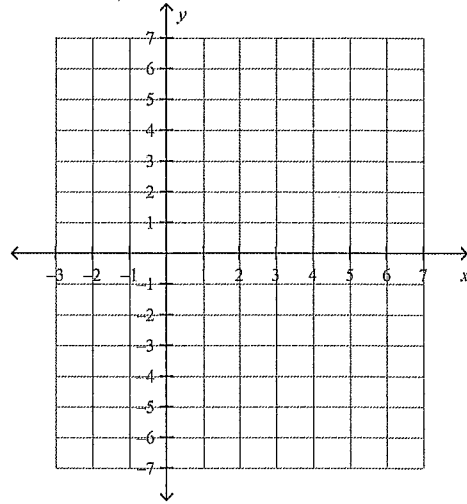
205. Find the area of the region bounded by $y = x^2 - 4x + 5$, the y -axis, $x = 3$ and the x -axis.



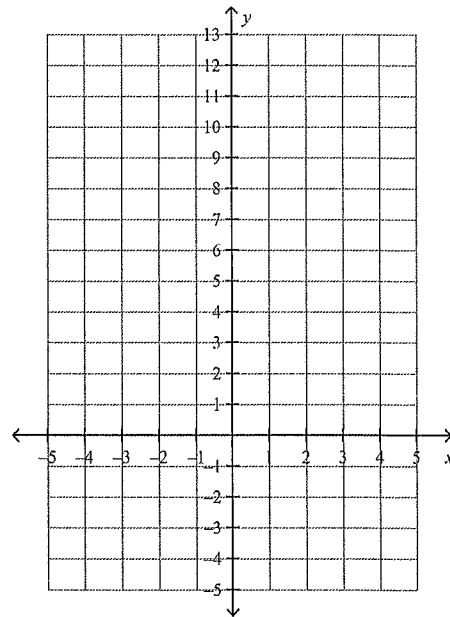
206. Find the area of the region bounded by the graphs of $y = 3x - x^2$ and $y = -x$.



207. Find the volume of the solid formed by revolving the region bounded by the graphs of $y = 3x$, $y = 6$ and $x = 4$, around the x -axis.



208. Write, and evaluate using a calculator, a definite integral that represents the volume of the solid formed by revolving the region in quadrant 2 bounded by $y = 4$, $y = \sqrt{x + 3}$, $x = -3$, about the line $y = 6$.



Name: _____

ID: A

209. The base of a solid with cross-sections perpendicular to the x -axis is bounded by the graphs of $y = \sqrt{25 - x^2}$, $y = 3$ and the y -axis. Write, but do not evaluate the definite integral to find the volume of the solid where:

a) Each cross-section is a rectangle with height half as tall as its width.

b) Each cross section is a semi-circle.

c) Each cross section is an equilateral triangle.

AP Calculus BC Summer Packet

Answer Section

NUMERIC RESPONSE

1. $\frac{1}{4}$
2. $2x^{4y+3}$
3. $\frac{5}{4x^{11}y^4}$
4. $\frac{15y^2}{2bx}$
5. $4g^2 - 6g + 3$
6. $9x^8 - 42x^4y^3 + 49y^6$
7. $3x^4 + 2x^3 - 7x^2 + 6x - 9$
8. $243x^5 - 810x^4 + 1080x^3 - 720x^2 + 240x - 32$
9. a) $(a-10)(a+4)$ b) $(3y-1)(2y+5)$ c) $3mm(2m-5)(2m+5)$
d) $(7x-10y)(7x+10y)$ e) $(6x-5y)(p+7)$
10. a) $5x \cdot y^2 \cdot (-x^3 + 4y + 3y^2)$ b) $(3x+1) \cdot (x^2-5)$ c) $5(2x-5) \cdot (2x+5)$
d) $(2x-3y)^2$ e) $(x-3-2y)(x-3+2y)$
11. $(5a-2b^2) \cdot (25a^2 + 10a \cdot b^2 + 4b^4)$
12. $3(x^2+5)^4 \cdot (x-1)^3 \cdot (7x^2-4x+15)$
13. $\frac{x^2+6}{\sqrt{x^2+4}}$
14. $3x^4 - x^3 + 2x^2 - 4x + 9 - \frac{13}{x+2}$
15. $x^3 - x + 1 + \frac{-7x+9}{x^2+x-7}$
16. $\frac{a+x}{-3a}$
17. $\frac{-w}{5(w-y)}$
18. $\frac{x^2+4x+16}{(x+4)^2}$
19. $\frac{y(x+1)}{x(y-x)}$

20. $\frac{x+9}{x^2+2x-1}$
21. $\frac{7x-2}{2(2x-1)(x-3)}$
22. $\frac{-3x-7}{(x-5) \cdot (x+4)}$
23. a) $12 \sqrt[3]{3} + 6 \sqrt[3]{6}$ b) $16\sqrt{15} - 60\sqrt{3}$ c) $3 - 5x$
 d) $32m^{\frac{3}{2}}$ e) $\frac{1}{9p^3}$ f) $\frac{x^9}{y^{12}}$ g) $\frac{1}{x^8 y^3}$
24. a) 16 b) -8 c) $\frac{1}{243}$ d) $\frac{343}{1,000,000} = 0.000343$
25. a) $3a^4b^5$ b) $36ab^2$
26. a) $\frac{2a \sqrt[3]{b^2}}{b}$ b) $\frac{\sqrt[4]{15}}{12}$ c) $-\sqrt{15} - 3\sqrt{2}$ d) $\frac{x \cdot \sqrt[5]{y^3}}{y}$
27. a) $-\frac{1}{\sqrt{3} - \sqrt{7}}$ b) $\frac{1}{3(\sqrt{x+3} + 5)}$
28. $\frac{2}{\sqrt[4]{x-4}}$
29. $\frac{-16(2x+1)}{(2x-1)^3}$
30. $\frac{1}{4x-5y}$
31. a) $3 - 5i$ b) $24 + 18i$ c) $-24 - 70i$ d) $\frac{3}{13} - \frac{11}{13} \cdot i$ e) $\frac{3}{4} - \frac{5}{4}i$ f) $-i$
32. $4 \ln(x) + \frac{1}{2} \cdot \ln(x-1) - \ln(2x+3)$
33. $\log\left(\frac{x^5 \cdot (x-1)^4}{\sqrt[3]{x^2+1}}\right)$
34. π
35. 1800
36. $\frac{-4}{7}$
37. -6

COMPLETION

38. $x = -1$
39. $y = \frac{45}{13}$

40. $x = 6$

41. $x = 4, x = -\frac{2}{3}$

42. a) $x = \frac{11d-b}{a-11c}$

b) $x = \frac{cab}{a+b}$

c) $b = \frac{-ax}{x-ac}$ or $\frac{ax}{ac-x}$

43. a) $n = 0, 3, \text{ or } \frac{-5}{2}$

b) $x = -10, 2$

c) $x = -\frac{6}{5}, x = \frac{7}{4}$

d) $x = 5 \text{ or } \frac{3}{4}$

e) $x = \frac{3 \pm \sqrt{39}}{3}$

44. $x = -4 \pm i\sqrt{6}$

45. $x = 3 \pm \frac{5\sqrt{2}}{2}$

46. $x = 3 \pm i$

47. $x = -\frac{4}{5} \cdot i, \frac{4}{5} \cdot i$

48. $x = \sqrt[3]{10}, x = -1$

49. $x = \frac{1}{8} \text{ or } 27$

50. $x = \frac{11}{6}$

51. $x = \frac{-1}{2} \text{ or } \frac{1}{3}$

52. a) $x = 7$ b) $b = 6$ (reject $b = 1$)

53. $x = -5$

54. $x = \frac{2\ln 4 + 4\ln 3}{5\ln 3 - 3\ln 4}$

55. 16; 216

56. $x = 8 \text{ or } -2$

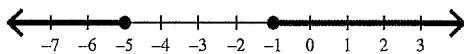
57. $\ln\left(\frac{2}{25}\right)$

58. $x = \frac{\ln 2}{2}$

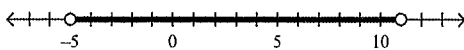
59. $x = 7 - e^2$

60. $x = \pm \frac{1}{2}$

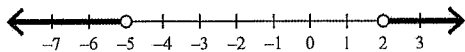
61. $x \leq -5 \text{ or } x \geq -1$



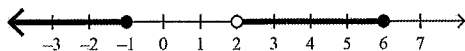
62. $-5 < x < 11$



63. $(-\infty, -5) \cup (2, \infty)$

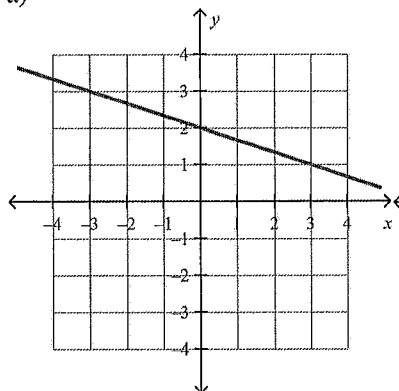


64. $(-\infty, -1] \cup (2, 6]$

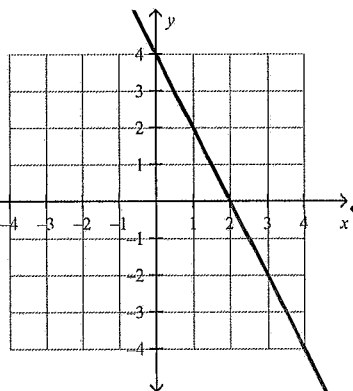


SHORT ANSWER

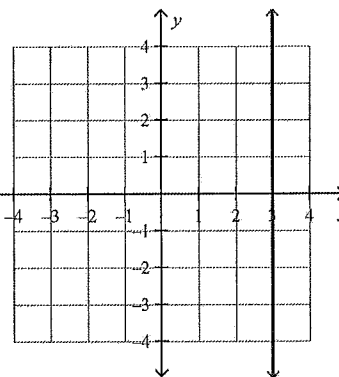
65. a)



b)



c)



66. a) $-\frac{3}{2}$ b) 2 c) $\frac{2}{3}$ d) 0 e) $\frac{5}{6}$

67. $m_1 = \frac{-2}{3}$, $m_2 = \frac{-3}{2}$

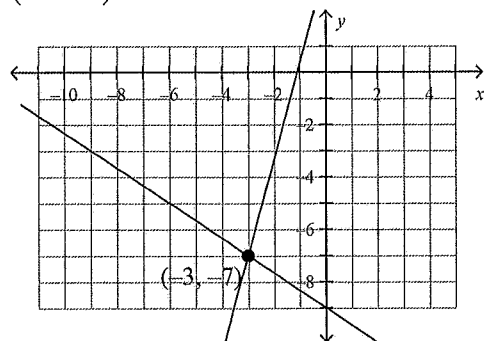
Since these slopes are neither equal nor opposite reciprocals, the lines are neither parallel nor perpendicular.

68. $y + 11 = 2(x + 1)$

$2x - y = 9$

69. $(-4, -21)$

70. $(-3, -7)$

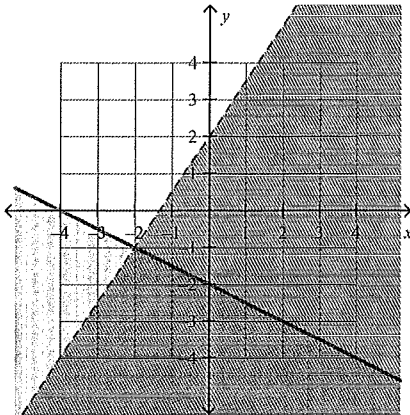


71. No solution.

72. $(2, 1)$

73. $(-4, -7)$

74.



75. $2\sqrt{10}$; $(1, -2)$

76. You need to find the slopes and lengths of all the sides. If the consecutive sides are all congruent and perpendicular, then the shape is a square.

77. $(-5, 7)$ and $(1, 1)$

78. $(3, -2)$; 4

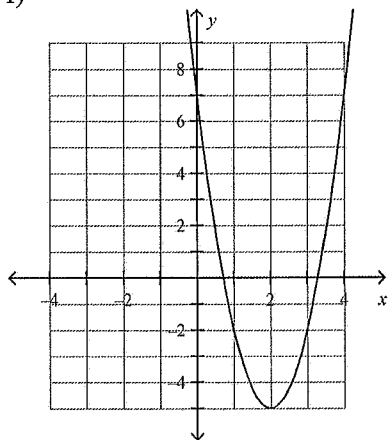
79. $k = 3$

ESSAY

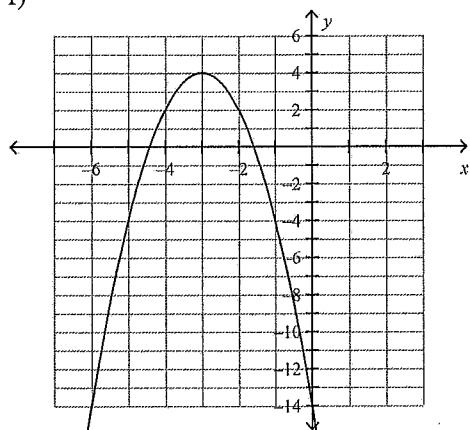
80. a) -7 b) $-18m^2 + 3m + 3$ c) $-2p^{10} + p^5 + 3$ d) $-2x^2 - 4xh - 2h^2 + x + h + 3$

81. 3; 2; -2 ; 1; 0; $[-5, 3]$; $[-2, 3]$

82. a) $f(x) = 3(x-2)^2 - 5$
 b) Vertex $(2, -5)$ minimum
 c) $x=2$
 d) x intercepts $x = 2 \pm \sqrt{\frac{5}{3}}$
 $\approx 2 \pm 1.3$
 ≈ 0.7 and 3.3
 e) $f(0) = 7$
 f)



83. a) $f(x) = -2(x+3)^2 + 4$
 b) Vertex $(-3, 4)$ maximum
 c) $x = -3$
 d) x intercepts $x = -3 \pm \sqrt{2}$
 $\approx -3 \pm 1.4$
 ≈ -1.6 and -4.4
 e) $f(0) = -14$
 f)



84. $\left[\frac{7}{8}, \infty \right)$

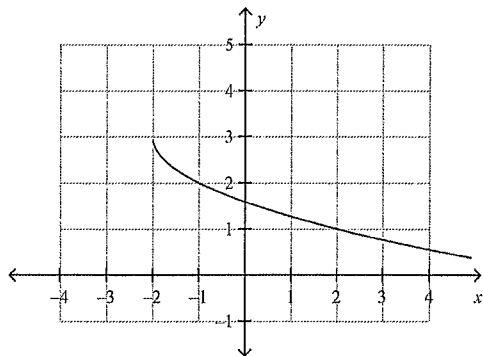
85. $(-\infty, -2) \cup (-2, 2) \cup (2, \infty)$

86. $(-\infty, -4] \cup [8, \infty)$

87. $\left[\frac{-2}{7}, \frac{3}{2}\right)$

88. reflect over the x axis ; vertical shrink by a factor of 2 ; shift 5 units right.

89.



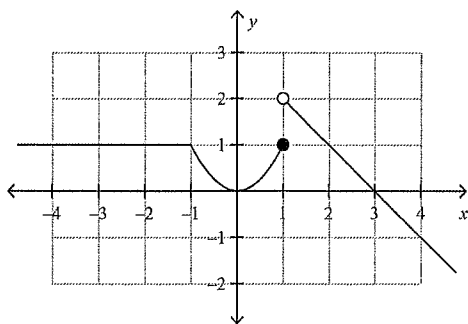
D $[-2, \infty)$

R $(-\infty, 3]$

90. odd

91. $0; -\frac{7}{4}; -3; 0; -9$

92.



93.

$$\begin{cases} -x-3 & \text{if } x < -2 \\ \sqrt{4-x^2} & \text{if } -2 \leq x \leq 2 \\ 3 & \text{if } x > 2 \end{cases}$$

94. a

95. a

96. a) Dec : $[-3, -1]$ Inc: $(-\infty, -3] \cup [-1, \infty)$

b) rel min value ≈ 0.8 rel max value = 2

97. $\frac{5}{6}$

98. $-4, 2a + h - 6$

99. The DQ represents the slope between any two points on the function whose x values are h units apart.

$$100. \frac{1}{\sqrt{x+h+3} + \sqrt{x+3}}; 3x^2 + 3xh + h^2 - 4; \frac{-3}{(x+h+5)(x+5)}$$

$$101. \sqrt[5]{58-9x^5}; -9x-2$$

$$102. f(g(h(x))) = \frac{5}{(x^2+4)^3} = \frac{5}{x^6+12x^4+48x^2+64}$$

$$103. 3$$

$$104. f^{-1}(x) = \sqrt[3]{8 - \sqrt[5]{x}}$$

$$105. f^{-1}(x) = \frac{7x+3}{-2x+5}$$

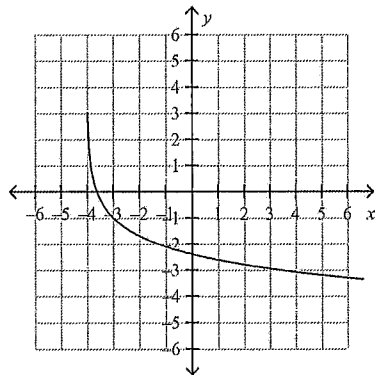
$$106. (2x-1)(x+3)(x-1)$$

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

$$107. Q(x) = x^4 - 3x^3 + 49x^2 - 147x$$

$$108. y = 3, x = 4, x = -1$$

109.



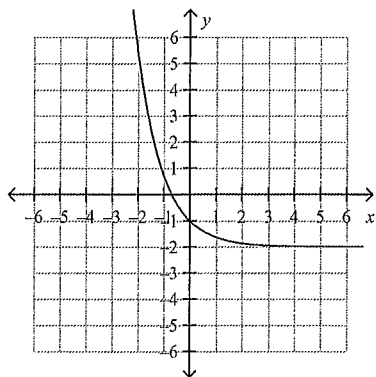
Domain $(-4, \infty)$

Range $(-\infty, \infty)$

Asy: $x = -4$ Intercepts: $x = \frac{1}{e} - 4, y = -\ln(4) - 1$

110. a and c only

111.

Domain $(-\infty, \infty)$ Range $(-2, \infty)$ Asy: $y = -2$ Intercepts: $x = -\ln 2$, $y = -1$

112. b and d only

CASE

113. a and c

114. a, d, e and b, f

115. $\left(-\frac{1}{2}, \frac{\sqrt{3}}{2}\right)$

116. $\frac{5}{6}\pi$

117. -135

118. $\frac{3\pi}{4}$

119. 60; 45; 30, $\frac{\pi}{3}$; $\frac{2\pi}{5}$

120. $\frac{2\sqrt{3}}{3}$; -2; $-\frac{\sqrt{3}}{3}$; undefined; -1

121. $\frac{\sqrt{2}}{4} \cdot (1 + \sqrt{3})$

122. $\frac{6}{\sqrt{37}}$; $\frac{1}{\sqrt{37}}$; $\frac{\sqrt{37}}{6}$; $\sqrt{37}$; $\frac{1}{6}$

123. $1 - \sin(x)$

124. $1 - \tan(x) \cdot \tan(y)$

125. $\frac{\sqrt{2 - \sqrt{3}}}{2}$

126. $2\sin(3x) \cdot \cos(3x)$

127. a) $\frac{5\pi}{6}$ b) $\frac{-\pi}{4}$ (NOT $\frac{3\pi}{4}$ or $\frac{7\pi}{4}$) c) $\frac{-\pi}{6}$ (NOT $\frac{7\pi}{6}$ or $\frac{11\pi}{6}$) d) undefined e) $\frac{-\pi}{2}$

128. $\frac{13}{5}$

129. $\frac{\sqrt{49-x^2}}{x}$

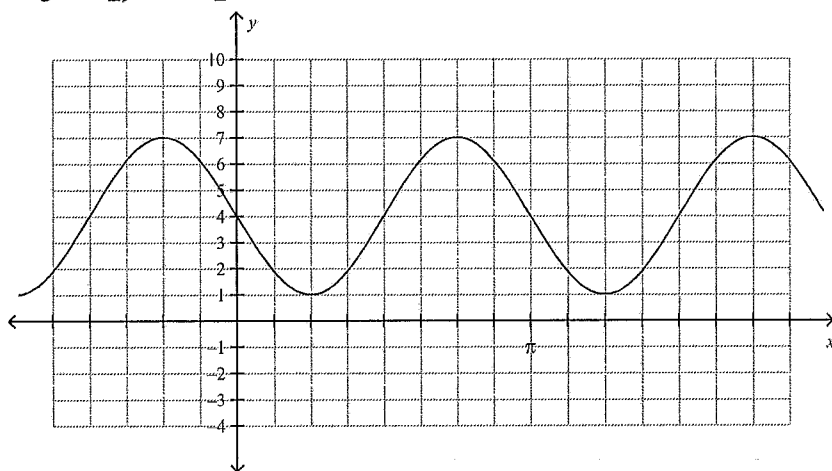
130. $x = \frac{\pi}{3} + 2k \cdot \pi, \frac{5\pi}{3} + 2k \cdot \pi$ where k is an integer.

131. $x = \frac{\pi}{2} + \frac{2\pi}{3}k$, where $k \in \mathbb{Z}$ where k is an integer.

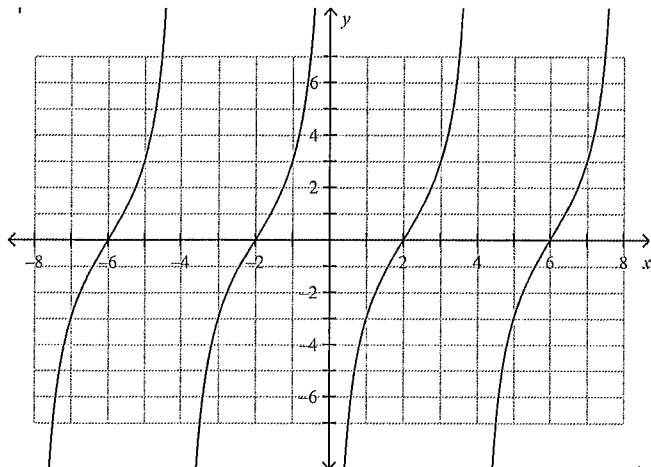
132. $x = \frac{\pi}{20} + \frac{\pi}{2}k$, where k is an integer.

133. $\left[\frac{\pi}{6}, \frac{5\pi}{6}\right] \cup [\pi, 2\pi)$

134. $\frac{-\sqrt{29}}{5}, \frac{20}{29}, \frac{\sqrt{29}+5}{-2}$



135. Amplitude = 3 Period = π Domain $(-\infty, \infty)$ Range $[1, 7]$



136.

Period = 4 Domain $\{x \mid x \neq 4k, \text{ where } k \in \mathbb{Z}\}$ Range $(-\infty, \infty)$

PROBLEM

137. 113, 115, 117, 119

138. $n = 23$

139. 220 calories

140. The cost is \$1500 for 1000 copies.

141. They must sell at least 500 radios.

142. angle= 45° , comp= 45° , supp = 135° 143. $x = 12$; $P = 102$ 144. $A = 16\sqrt{5}$ $P = 20 + 4\sqrt{5}$ 145. $h = 18in$ 146. $6x + 22$

147. \$7,000; \$6,000

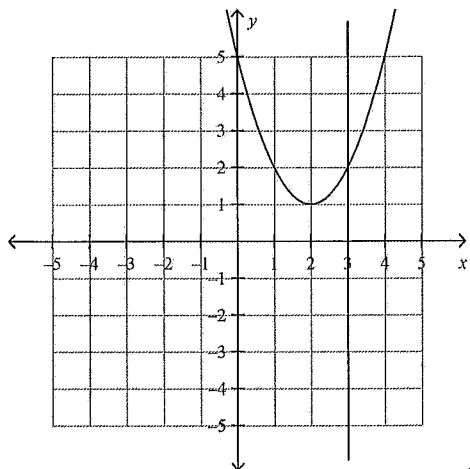
148. 30.03; 41.75; 44

149. 108.1, 121.9

150. $d = 6$, $SA = 69\pi$ 151. $A(w) = w^2 + 12w$ 152. $h(r) = \frac{240}{\pi \cdot r^2}$ 153. $A(w) = \frac{5}{2} \cdot w \cdot (130 - w)$; 10,562.5**OTHER**154. $\frac{1}{10}$ 155. $\frac{12}{-5}$

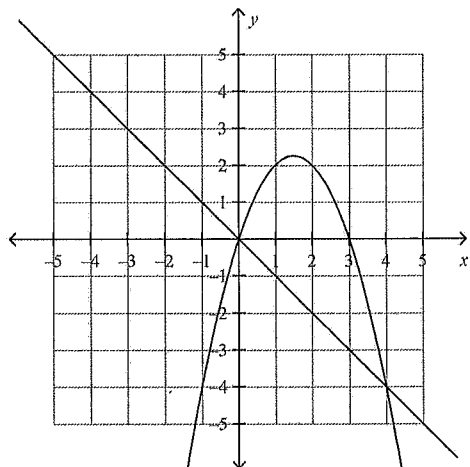
156. DNE, limits from the left and right are not equal
157. 2
158. $\frac{-3}{4}$
159. $\frac{1}{4}$
160. a
161. 1
162. $+\infty$ (DNE)
163. $\frac{1}{5}$
164. -1, -1, -1, 2, No because $\lim_{x \rightarrow 1} f(x) \neq f(1)$
165. ∞ , 1, DNE, 1, No b/c $L \neq R$ and unbounded behavior.
166. ∞ , 1, DNE, 1, No b/c $L \neq R$
167. ∞ , 1, DNE, 1, No b/c $\lim_{x \rightarrow 1} f(x) \neq f(1)$
168. $x = 3$ removable $x = 2$ non-removable
169. $\frac{6}{5}$
170. $x = 1$ VA $y = 0$ HA $\left(-1, \frac{-1}{2}\right)$ hole
171. $f'(x) = \frac{3}{5}x^{\frac{-2}{5}} - 28x^{-8}$
172. $\frac{-2(3x^3 \sin 2x^3 + 2 \cos 2x^3)}{3x^5}$
173. $\frac{dy}{dx} = \frac{5 \sec^2(5\sqrt{x})}{2\sqrt{x}}$
174. $f'(x) = \frac{6x^2 - 5}{4(2x^3 - 5x)^{\frac{3}{4}}}$
175. $f'(x) = e^{5x}(5 \cos 7x - 7 \sin 7x)$
176. $g'(x) = \sqrt{x} \left(1 + \frac{3}{2} \ln x\right)$
177. $h'(x) = \cos 2x$
178. 2
179. 6
180. $2\pi + 2$
181. $\ln x + x + c$
182. $\frac{1}{3}e^{3y} + c$

183. $\frac{2}{3} \sin^{\frac{3}{2}} x + c$
184. $\frac{1}{3} \ln|t^3 + 1| + c$
185. $\frac{1}{8}$
186. $\ln(1 + e^x) + c$
187. $-4 \csc x + c$
188. $-\frac{3}{2} \sqrt{1 - 4x} + c$
189. $\frac{-3}{2} \cot(x^2) + c$
190. $\frac{-1}{2} \ln|\cos 10x| + c$
191. $2 \ln|2x - 3| + c$
192. $\frac{1}{9}$
193. $\sqrt{2} - 2$
194. 21
195. $f'(x) = \frac{8x}{(4x^2 + 1)^3}$; $y - \frac{4}{9} = \frac{8}{125}(x - 1)$
196. $\frac{dy}{dx} = \left(\frac{5}{x} + \ln 5\right) x^5 \cdot 5^x$
197. $y' = \frac{3x^2}{2x^3 - 6}$
198. $e^4 \left(\frac{3}{2} + 6 \ln 4\right)$
199. $f(x) = 6x^{\frac{4}{3}} + 2$
200. $f(x) = \frac{2}{3}x^3 + \frac{1}{2}x^2 + x + 3$
201. $s(t) = 5t^2 - 2t + 4$
202. $y = -\sqrt{4x^2 + 6x + 26}$
203. 8
204. 60; 63; $\frac{-1}{2}$



205.
206.

$$A = 6$$



$$A = \frac{32}{3}$$

207. $V = 96\pi$

208. $V = \int_{-3}^0 \left(\pi(6 - \sqrt{x+3})^2 - \pi(2)^2 \right) dx = 581.623$

209. $V = \int_0^4 \frac{1}{2} \left(\sqrt{25-x^2} - 3 \right)^2 dx$; $V = \int_0^4 \frac{\pi}{2} \left(\frac{\sqrt{25-x^2} - 3}{2} \right)^2 dx$; $V = \int_0^4 \frac{\sqrt{3}}{4} \left(\sqrt{25-x^2} - 3 \right)^2 dx$