YOU WILL BE TESTED ON MATERIAL IN PACKETS A, B, and C WITHIN FIRST WEEK OF SCHOOL. THESE PACKETS SHOULD BE COMPLETED BY FIRST DAY OF CLASS.

AP Calculus Summer Review Packet (A)
(Review of Honors PreCalculus)

The following problems represent a review of some of the fundamental concepts you need as you enter AP Calculus AB. They cover material you have learned in past math classes, particularly Honors PreCalculus. You are encouraged to refer to your notes, any textbooks, or online resources to guide you through this assignment. Answers are provided at the end of the document.

Complete the entire packet on loose leaf, showing all work and steps. All problems should be done without a calculator. Bring this work with you to the first class in September.

SHOW ALL WORK clearly.

Simplify as fully as possible. Leave final answers with only positive exponents.

1. $\dfrac{6x^{5/2} \cdot \sqrt[3]{x^2}}{12\sqrt{x}}$

2. $\dfrac{6x^2 - 12x^{3/2} + 8x^8}{2x^2}$

Simplify as fully as possible. Leave final answers in factored form.

3. $\dfrac{x^2 - 25}{x^2 - 4x - 5} \div \dfrac{2x + 10}{x^2 - 1}$

4. $\dfrac{(x-3)^3 (x+2)^{-1} (x^2 - 9)}{(x-3)^5 (x+2)^{-2}}$

Solve each equation for x over real numbers. Give exact answers.

5. $\sqrt{2x+7} - x = 2$

6. $2(x-2)^{3/2} = 54$

7. $e^{2x} - e^x = 0$

8. $16x^4 - 1 = 0$

9. $2x^4 - 14x^2 + 24 = 0$

10. $x \ln x = x$

11. $\left| x^2 - 3x \right| = 6 - 4x$

12. $4x^3 - 8x^2 - 25x + 50 = 0$

13. $\log_2(x+5) - \log_2 x = 1$

14. $\dfrac{x}{x-2} + \dfrac{1}{x+2} = \dfrac{-4}{x^2 - 4}$

15. $4^{3x} = 2^{x^2 + 8}$

16. Use the quadratic formula to find the exact solution to $x^4 - 5x^2 + 3 = 0$.

Inequalities

17. Solve and graph on a number line: $2x^3 - 7x^2 \geq -3x$ (use critical numbers and a sign graph)

18. Solve and graph on a number line: $\dfrac{x+3}{x-2} \geq 2$ (use critical numbers and a sign graph)

Factor Completely:

19. $4x^2(x+1)(x-3) - 8x(x-3)^2$

20. $(x-3)^2 - 2x(x-3)$

21. $2\sqrt{x} + 6x^{3/2} - 10x^2$ (Hint: take out GCF)

Functions

Use $f(x) = \sqrt{x-3}$ and $g(x) = x^2 - 1$ for #22 and 24.

22. Determine $(g \circ f)(x)$, in simplified form.

23. Determine $f(g(4))$.

24. State the domain of $(f \circ g)(x)$ in interval notation.

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25. Sketch $f(x) = 4 - 2^{x-1}$ (no calculator), and state its domain and range.

26. Rewrite $f(x) = -2|x+3| - 4$ as a piecewise function.

27. Sketch $y=\sqrt{16-x^2}$ on graph paper (no calculator). State the domain and range.

28. Sketch the piecewise function below on graph paper to find the domain and range.

$$f(x)=\begin{cases} 3-x^2, & x\le-1 \\ 4, & -1<x<2 \\ 3x-2, & x\ge2 \end{cases}$$

29. Use the function in #28 to evaluate a-e:

  a. $f(3)$ b. $f(-3)$ c) $f(2)$ d. $f(0)$ e. $f(-1.3)$

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30. Discuss the end behavior of $g(x) = -4x^7 - 5x^5 + 3x^4 + 4x^3 - x^2 + 2x - 6$.

31. Determine the zeros, vertical asymptote(s), horizontal asymptote(s), and holes (as points) for

$$f(x) = \frac{x^2+x-6}{x^3-4x}$$

32. Use $f(x)=2x^2+1$ to evaluate a) $f(x+h)$ and b) $f(x+h)-f(x)$.

33. Is $f(x)=5x^4-3x^2-1$ odd, even, or neither? Justify analytically.

34. Describe any symmetry (about x-axis, y-axis, origin) for $y = \frac{x^2+1}{x}$.

35. Let $f(x)=\frac{3x+7}{x-2}$. Find a. $f^{-1}(x)$ and b. $f^{-1}(-10)$.

Equations, Graphs, and Intersections of graphs

36. Find the equation of the line in standard form that contains the vertex of the parabola $y = 2x^2 - 12x + 16$ and is parallel to $2x - 3y = 6$.

37. Find an equation for the parabola whose vertex is $(2,-5)$ and passes through $(4, 7)$. Express answer in standard quadratic form.

38. Find the point(s) of intersection of the curves $x^2 + 3x - y = 2$ and $y - 5x = 1$, analytically.

39. ~~Graphically~~ determine the point(s) of intersection of $x^2 + y^2 = 4$ and $x^2 + y^2 - 4x - 4y = -4$.

40. Find the domain of $f(x) = \frac{\sqrt{x+5}}{x+2}$. Express your answer in interval notation.

Trigonometry

41. Evaluate the exact value of each trigonometric expression (no calculators).

a. $\tan\dfrac{3\pi}{4}$　　　b. $\sec\left(-\dfrac{\pi}{2}\right)$　　　c. $\sin\left(-\dfrac{7\pi}{3}\right)$　　　d. $\cos(3\pi)$

42. Evaluate the exact value of each inverse trig function.

a. $Sin^{-1}\dfrac{\sqrt{3}}{2}$　　　b. $arccos(-1)$　　　c. $Tan^{-1}\sqrt{3}$　　　d. $Cos^{-1}(0)$

43. Evaluate the exact value for the expression: $\sin(2\theta) + \cos^2\left(\dfrac{\theta}{2}\right)$, when $\theta = \dfrac{\pi}{3}$.

Solve for θ if $0 \le \theta \le 2\pi$.

44. $\cos\theta = -\dfrac{\sqrt{3}}{2}$

45. $\sin 2\theta - \cos\theta = 0$

46. $2\sin^2\theta - 3\sin\theta + 1 = 0$

47. $\cos^2\theta + \sin\theta = 1$.

ANSWERS

SHOW ALL WORK clearly.

1. $\frac{1}{2}x^{8/3}$

2. $3 - \frac{6}{\sqrt{x}} + 4x^6$

3. $\frac{x-1}{2}$

4. $\frac{(x+2)(x+3)}{x-3}$

5. $x=1$

6. $x=11$

7. $x=0$

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

9. $x=\pm2,\pm\sqrt{3}$

10. $x=0,e$

11. $x=-3,1$

12. $x=-\frac{5}{2},2,\frac{5}{2}$

13. $x=5$

14. $x=-1$

15. $x=2,4$

16. $x=\pm\sqrt{\frac{5\pm\sqrt{13}}{2}}$

17. $\left[0,\frac{1}{2}\right]\cup[3,\infty)$

18. $(2,7]$

19. $4x(x-3)(x^2-x+6)$

20. $-(x-3)(x+3)$

21. $2\sqrt{x}(1+3x-5x^{3/2})$

22. $(g\circ f)(x)=x-4$

23. $2\sqrt{3}$

24. $(-\infty,-2]\cup[2,\infty)$

25. Domain = all real numbers, Range $=(-\infty,4)$

26. $\begin{cases} 2x+2, x<-3 \\ -2x-10, x\geq-3 \end{cases}$; domain = all reals, range $=(-\infty,-4]$

27. Upper semicircle centered at (0, 0) with radius r = 4; domain is [−4,4], range is [0, 4]

28. Domain = all reals, Range = $(-\infty,2]\cup[4,\infty)$

29. a. 7 b. −6 c. 4 d. 4 e. 1.31

30. As $x\to-\infty, g(x)\to+\infty$, As $x\to+\infty, g(x)\to-\infty$

31. Hole at $\left(2,\frac{5}{8}\right)$; vertical asymptote $x=0$ and $x=-2$; horizontal asymptote $y=0$

32. a) $f(x+h)=2x^2+4xh+2h^2+1$ and
    b) $f(x+h)-f(x)=4xh+2h^2$

33. It is even because $f(-x)=f(x)$.

34. origin

35. $f^{-1}(x)=\frac{-7-2x}{3-x}$; $f^{-1}(-10)=1$

36. $2x-3y=12$

37. $y=3x^2-12x+7$

38. $(3,16),(-1,-4)$

39. $(0,2),(2,0)$

40. $[-5,-2)\cup(-2,\infty)$

41. a. -1 b. undefined c. $-\frac{\sqrt{3}}{2}$ d. -1

42. a. $\frac{\pi}{3}$ b. π c. $\frac{\pi}{3}$ d. $\frac{\pi}{2}$

43. $\frac{\sqrt{3}}{2}+\frac{3}{4}$

44. $\frac{5\pi}{6},\frac{7\pi}{6}$

45. $\frac{\pi}{6},\frac{\pi}{2},\frac{5\pi}{6},\frac{3\pi}{2}$

46. $\frac{\pi}{6},\frac{\pi}{2},\frac{5\pi}{6}$

47. $0,\frac{\pi}{2},\pi$

Simplify

1. $\dfrac{x^3-9x}{x^2-7x+12}$

2. $\dfrac{x^2-2x-8}{x^3+x^2-2x}$

3. $\dfrac{\frac{1}{x}-\frac{1}{5}}{\frac{1}{x^2}-\frac{1}{25}}$

4. $\dfrac{9-x^{-2}}{3-x^{-1}}$

Rationalize the denominator

5. $\dfrac{2}{\sqrt{3}+\sqrt{2}}$

6. $\dfrac{4}{1-\sqrt{5}}$

7. $\dfrac{1-\sqrt{5}}{1+\sqrt{3}}$

Write each of the following expressions in the form of $ca^p b^q$ where c, p, and q are numbers

8. $\dfrac{(2a^2)^3}{b}$

9. $\sqrt{9ab^3}$

10. $\dfrac{a(2/b)}{3/a}$

11. $\dfrac{ab-a}{b^2-b}$

12. $\dfrac{a^{-1}}{(b^{-1})\sqrt{a}}$

13. $\left(\dfrac{a^{2/3}}{b^{1/2}}\right)^2 \left(\dfrac{b^{3/2}}{a^{1/2}}\right)$

Solve for x. Do not use a calculator

14. $5^{(x+1)}=25$

15. $\dfrac{1}{3}=3^{2x+2}$

16. $\log_2 x = 3$

17. $\log_3 x^2 = 2\log_3 4 - 4\log_3 5$

Simplify

18. $\log_2 5 + \log_2(x^2-1) - \log_2(x-1)$

19. $2\log_4 9 - \log_2 3$

20. $3^{2\log_3 5}$

Simplify

21. $\log_{10} 10^{1/2}$

22. $\log_{10}\dfrac{1}{10^x}$

23. $2\log_{10}\sqrt{x} + 3\log_{10} x^{1/3}$

Solve the following equations for the indicated variable

24. $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$, for a

25. $V = 2(ab + bc + ca)$, for a

26. $A = 2\pi r^2 + 2\pi rh$, for positive h

27. $A = P + \pi rP$, for P

28. $2x - 2yd = y + xd$, for d

29. $\frac{2x}{4\pi} + \frac{1-x}{2} = 0$, for x

For each equation complete the square and reduce to one of the standard forms $y - y_1 = A(x - x_1)^2$ or $x - x_1 = (y - y_1)^2$

30. $y = x^2 + 4x + 3$

31. $3x^2 + 3x + 2y = 0$

32. $9y^2 - 6y - 9 - x = 0$

Factor completely

33. $x^6 - 16x^4$

34. $4x^3 - 8x^2 - 25x + 50$

35. $8x^3 + 27$

36. $x^4 - 1$

Find all real solutions

37. $x^6 - 16x^4 = 0$

38. $4x^3 - 8x^2 - 25x + 50 = 0$

39. $8x^3 + 27 = 0$

~~Answer~~

~~40.~~ ~~~~

~~41.~~ ~~~~

~~42.~~ ~~~~

Without using a calculator, evaluate the following:

43. $\cos 210°$

44. $\sin \frac{5\pi}{4}$

45. $\tan^{-1}(-1)$

46. $\sin^{-1}(-1)$

47. $\cos \frac{9\pi}{4}$

48. $\sin^{-1}\left(\frac{\sqrt{3}}{2}\right)$

49. $\tan\left(\frac{7\pi}{6}\right)$

50. $\cos^{-1}\left(\sin\left(-\frac{\pi}{4}\right)\right)$

Given the graph of $y = \sin x$, sketch the graphs of:

51. $\sin\left(x - \frac{\pi}{4}\right)$

52. $\sin\left[\left(\frac{\pi}{2}\right)x\right]$

53. $2\sin x$

54. $\cos x$

55. $\dfrac{1}{\sin x}$
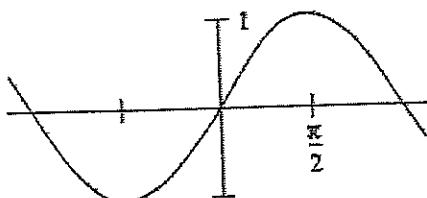
Solve the equations

56. $4x^2 + 12x + 3 = 0$

57. $2x + 1 = \dfrac{5}{x+2}$

58. $\dfrac{x+1}{x} - \dfrac{x}{x+1} = 0$

Find the remainders on division of

59. $x^5 - 4x^4 + x^3 - 7x + 1$ by $x + 2$

60. $x^5 - x^4 + x^3 + 2x^2 - x + 4$ by $x^3 + 1$

61. The equation $12x^3 - 23x^2 - 3x + 2 = 0$ has a solution $x = 2$. Find all other solutions.

62. Solve for x, the equation $12x^3 + 8x^2 - x - 1 = 0$ (all solutions are rational and between ± 1)

Solve the inequalities. Give the solution in interval notation

63. $x^2 + 2x - 3 \le 0$

64. $\dfrac{2x-1}{3x-2} \le 1$

65. $\dfrac{2}{2x+3} > \dfrac{2}{x-5}$

Solve for x. Give the solution in interval notation

66. $|-x + 4| \le 1$

67. $|5x - 2| = 8$

68. $|2x + 1| > 3$

Determine the equation of the following lines

69. The line through $(-1, 3)$ and $(2, -4)$

70. The line through $(-1, 2)$ and perpendicular to the line $2x - 3y + 5 = 0$

71. The line through $(2, 3)$ and the midpoint of the line segment from $(-1, 4)$ to $(3, 2)$

72. Find the point of intersection of the lines: $3x - y - 7 = 0$ and $x + 5y + 3 = 0$

73. Shade the region in the xy-plane that is described by the inequalities $\begin{cases} 3x - y - 7 < 0 \\ x + 5y + 3 \geq 0 \end{cases}$

Find the equations of the following circles:

74. The circle with center at $(1, 2)$ that passes through the point $(-2, -1)$

~~75. The circle that passes through the origin and has intercepts equal to 1 and 2 on the x and y axes respectively.~~

76. For the circle $x^2 + y^2 + 6x - 4y + 3 = 0$ find the center and the radius

77. Find the domain of $\frac{3x+1}{\sqrt{x^2+x-2}}$

Find the domain and range of:

78. $f(x) = 7$

79. $g(x) = \frac{5x-3}{2x+1}$

80. $f(x) = \frac{|x|}{x}$

Simplify $\frac{f(x+h)-f(x)}{h}$ when

81. $f(x) = 2x + 3$

82. $f(x) = \frac{1}{x+1}$

83. $f(x) = 3x^2 - x + 5$

The graph of the functions $y = f(x)$ is given as follows: Determine the graphs of the functions:

84. $f(x + 1)$
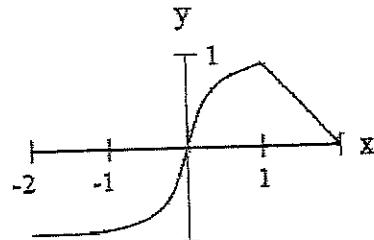
85. $f(-x)$

86. $|f(x)|$

Sketch the graphs of the functions

87. $g(x) = |3x + 2|$

88. $h(x) = |x(x - 1)|$

89. The graph of a quadratic function has x-intercepts -1 and 3 and a range consisting of all numbers less than or equal to 4. Determine an expression for the function.

90. Sketch the graph of the quadratic function $y = 2x^2 - 4x + 3$

Find the inverse of the functions

$x > 1$

91. $f(x) = 2x + 3$

93. $f(x) = x^2 - 2x - 1, x > 0$

92. $f(x) = \frac{x+2}{5x-1}$

94. A function $f(x)$ has the graph below. Sketch the graph of the inverse function $f^{-1}(x)$.
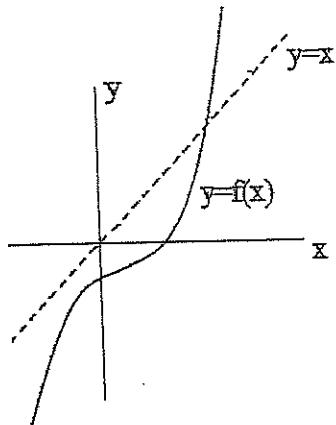

For problems 96 and 97, express x in terms of the other variables in the picture:

95.
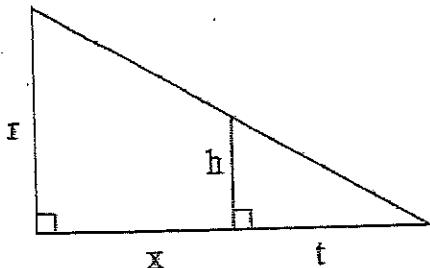
96.
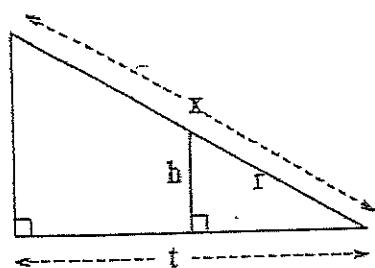
97. Find the ration of the area inside the square but outside the circle to the area of the square in the picture below
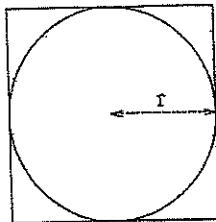
98. Find the formula for the perimeter of the window of the shape in the picture below
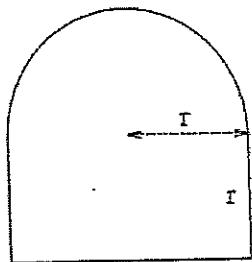
99. A water tank has the shape of a cone (like an ice cream cone without the ice cream). The tank is 10m high and has a radius of 3 m as the top. If the water is 5 m deep (in the middle) what is the surface area of the top of the water?

100.   Two cars start moving from the same point. One travels south at 100 km/hr, the other west at 50 km/hr. How far apart are they two hours later?

101.   A kite is 100 m above the ground. If there are 200 m of string out, what is the angle between the sting and the horizontal. (Assume that the string is perfectly straight)

If $f(x) = 2x - 3$ and $g(x) = \sqrt{3x - 1}$, Find:

102. $f\big(g(x)\big)$

103. $g\big(f(x)\big)$

104.   If $f(x) = \frac{3}{x}$ and $g(x) = \frac{x}{2x-1}$, Find $f\big(g(x)\big)$ and state its domain.

Decompose each composition function into individual function. (If $y = f(u)$, identify u and rewrite y in terms of u)

105. $y = \sin 3x$

106. $y = \sqrt[5]{2x + 1}$

107. $y = (x^2 - 2x + 5)^5$

108. $y = \cos^2 x$

Answers

1. $\dfrac{x^2+3x}{x-4}$

2. $\dfrac{x-4}{x^2-x}$

3. $\dfrac{5x}{x+5}$

4. $\dfrac{3x+1}{x}$

5. $2\left(\sqrt{3}-\sqrt{2}\right)$

6. $-1-\sqrt{5}$

7. $\dfrac{1-\sqrt{3}-\sqrt{5}+\sqrt{15}}{-2}$

8. $8a^6b^{-1}$

9. $3a^{1/2}b^{3/2}$

10. $\dfrac{2}{3}a^2b^{-1}$

11. ab^{-1}

12. $a^{-3/2}b$

13. $a^{5/6}b^{1/2}$

14. 1

15. $-\dfrac{3}{2}$

16. 8

17. $\pm\dfrac{4}{25}$

18. $\log_2\big(5(x+1)\big)$

19. $\log_2 3$

20. 25

21. $\dfrac{1}{2}$

22. $-x$

23. $2\log_{10} x$

24. $\dfrac{bcx}{bc-cy-bz}$

25. $\dfrac{V-2bc}{2(b+c)}$

26. $\dfrac{A-2\pi r^2}{2\pi r}$

27. $\dfrac{A}{1+\pi r}$

28. $\dfrac{2x-y}{x+2y}$

29. $\dfrac{\pi}{\pi-1}$

30. $y+1=(x+2)^2$

31. $y-\dfrac{3}{8}=-\dfrac{3}{2}\left(x+\dfrac{1}{2}\right)^2$

32. $x+10=9\left(y-\dfrac{1}{3}\right)^2$

33. $x^4(x-4)(x+4)$

34. $(x-2)(2x-5)(2x+5)$

35. $(2x+3)(4x^2-6x+9)$

36. $(x-1)(x+1)(x^2+1)$

37. $0,\pm 4$

38. $2,\pm\dfrac{5}{2}$

39. $-\dfrac{3}{2}$

40. $\dfrac{\pi}{6},\dfrac{5\pi}{6},\dfrac{7\pi}{6},\dfrac{11\pi}{6}$

41. $-\dfrac{\pi}{2},\dfrac{\pi}{6},\dfrac{5\pi}{6}$

42. $\dfrac{\pi}{6}+2k\pi$ and $\dfrac{5\pi}{6}+2k\pi$ where $k\in I$

43. $-\dfrac{\sqrt{3}}{2}$

44. $-\dfrac{\sqrt{2}}{2}$

45. $-\dfrac{\pi}{4}$

46. $-\dfrac{\pi}{2}$

47. $\dfrac{\sqrt{2}}{2}$

48. $\dfrac{\pi}{3}$

49. $\dfrac{\sqrt{3}}{3}$

50. $\dfrac{3\pi}{4}$

51.
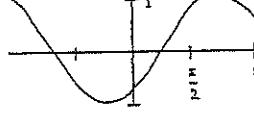
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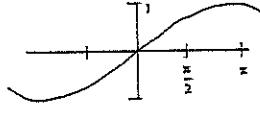
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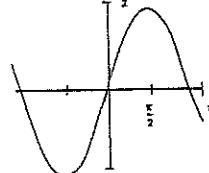
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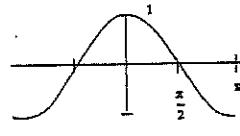
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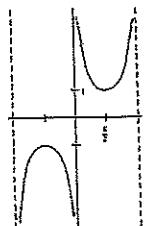
56. $\dfrac{-3 \pm \sqrt{6}}{2}$

57. $\dfrac{1}{2}$ or -3

58. $-\dfrac{1}{2}$

59. -89

60. $x^2 + 3$

61. $-\dfrac{1}{3}$ or $\dfrac{1}{4}$

62. $-\dfrac{1}{2}, -\dfrac{1}{3}, -\dfrac{1}{2}$

63. $[-3, 1]$

64. $\left(-\infty, \dfrac{2}{3}\right) \cup [1, \infty)$

65. $(-\infty, -8) \cup \left(-\dfrac{3}{2}, 5\right)$

66. $[3, 5]$

67. 2 and $-\dfrac{6}{5}$

68. $(-\infty, -2) \cup (1, \infty)$

69. $7x + 3y = 2$

70. $3x + 2y = 1$

71. $y = 3$

72. $(2, -1)$

73.
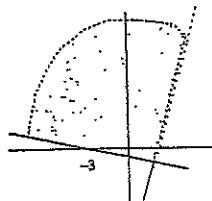
74. $(x - 1)^2 + (y - 2)^2 = 18$

75. $\left(x - \dfrac{1}{2}\right)^2 + (y - 1)^2 = \dfrac{5}{4}$

76. Center $= (-3, 2)$, radius $= \sqrt{10}$

77. $(-\infty, -2) \cup (1, \infty)$

78. Domain $(-\infty, \infty)$ Range $\{7\}$

79. Domain $\left(-\infty, -\dfrac{1}{2}\right) \cup \left(-\dfrac{1}{2}, \infty\right)$

    Range $\left(-\infty, \dfrac{5}{2}\right) \cup \left(\dfrac{5}{2}, \infty\right)$

80. Domain $(-\infty, 0) \cup (0, \infty)$

    Range $\{-1, 1\}$

81. 2

82. $\dfrac{-1}{(x+1)(x+h+1)}$

83. $6x + 3h - 1$

84.
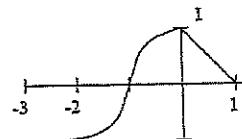
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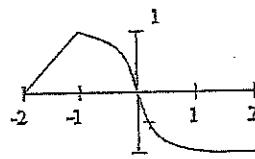
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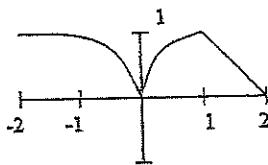
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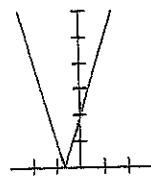
88.
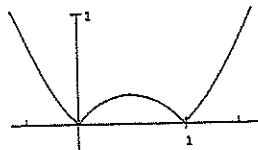
89. $y = -x^2 + 2x + 3$

90.
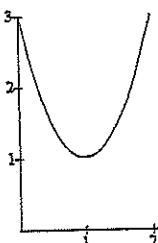
91. $f^{-1} = \dfrac{x - 3}{2}$

92. $f^{-1} = \dfrac{x + 2}{5x - 1}$

93. $f^{-1} = 1 + \sqrt{x+2}$ for $x \geq -1$

x ≥ -2

94.
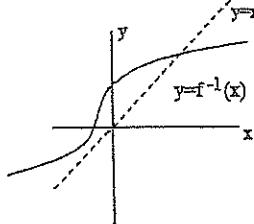
95. $x = t\left(\frac{r-h}{h}\right)$

96. $x = \frac{rt}{\sqrt{r^2-h^2}}$

97. $1 - \frac{\pi}{4}$

98. $4r + \pi r$

99. $\frac{9\pi}{4}$

100. $100\sqrt{5}\ KM$

101. $\frac{\pi}{6}$

102. $2\sqrt{3x-1} - 3$

103. $\sqrt{6x-10}$

104. $\frac{6x-3}{x}$

      Domain $(-\infty, 0) \cup \left(0, \frac{1}{2}\right) \cup \left(\frac{1}{2}, \infty\right)$

105.   Let $u = 3x$, then $y = \sin u$

106.   Let $u = 2x + 1$, then $y = \sqrt[5]{u}$

107.   Let $u = x^2 - 2x + 5$,

      then $y = u^5$

108.   Let $u = \cos x$, then $y = u^2$

AP CALC. SUMMER PACKET (C)   (6 PLACES PAST THE DECIMAL POINT!!!)

AP CALC. – CALCULATOR SKILLS

USE

INTERSECT

1. Find x-coordinates for which $y = x^3 - 2x + 1$ and $y = 3x - 1$ intersect.

ZERO

2. Solve the eq.: $(x^3 - 2x + 1) - (3x - 1) = 0$

MAXIMUM, **MINIMUM**

3. Find the x-coordinates of the relative maxs and rel. mins. of $y = x^3 - 2x^2 - 3x + 3$.

ZERO

4. Solve for x: $x^3 - 2x^2 - 3x + 3 = 0$.

INTERSECT

5. Find the pt. of intersection of the system: $2x - 5y = -5$
$-3x + 4y = -10$

ZERO, **MAXIMUM**, **MINIMUM**

6. For what x-values is ^{A} $f(x) > 0$ ^{B} $f(x) < 0$ ^{C} $f(x)$ is increasing ^{D} $f(x)$ is decreasing for the func. $f(x) = -x^4 + 6x^2 + 3x - 2$.

INTERSECT

7. Find x-coor's for which $y = x^3 + 1$ and $y = 4\sin(x^2)$ intersect. (MUST BE IN RADIANS)

8. Solve for x: $x^2 = 2^x$

ZERO

9. Solve for x: $x^3 + 1 - 4\sin(x^2) = 0$

① $X = -2.414214, .414214, 2$

② $X = -2.414214, .414214, 2$

③ $X = -.535185, 1.868519$

④ $X = -1.460505, .760877, 2.699628$

⑤ $2x - 5y = -5$ $5y = 2x + 5$, $y = \frac{2}{5}x + 1$ $(10, 5)$

    $-3x + 4y = -10$ $4y = 3x - 10$, $y = \frac{3}{4}x - \frac{5}{2}$

⑥   A. $f(x) > 0 : (-2, -1) \cup (.381966, 2.618034)$

    B. $f(x) < 0 : (-\infty, -2) \cup (-1, .381966) \cup (2.618034, \infty)$

    c. $f(x) \uparrow : (-\infty, -1.590071) \cup (-.255564, 1.845635)$

    d. $f(x) \downarrow : (-1.590071, -.255564) \cup (1.845635, \infty)$

    ZEROS: $x = -2, -1, .381966, 2.618034$

    MAX : $x = -1.590071, 1.845635$

    MIN: $x = -.255564$

⑦ $x = -.474535, .542303, 1.395703$

⑧ $x = -.766665, 2, 4$

⑨ $-.474535, .542303, 1.395703$