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## **Preparing students for the AP Calculus Exam during the school year**



### Websites:

- Mastermathmentor.com
- Edmodo.com
- Khanacademy.org
- <http://www.ncaapmt.org/calculus/>
- <http://apcentral.collegeboard.com/apc/Controller.jspf>
- <http://designatedderiver.wikispaces.com/>
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# BC 2011-2012

August 22 - September 30

First Six Weeks - all dates are subject to change

Monday	Tuesday	Wednesday	Thursday	Friday
August 22 Info sheet Name plate Syllabus POW- journal	23 Donated Items syllabus quiz TI 89 Info Discuss summer packet autobiography	24 Review Limits and Derivatives	25	26 Summer packet test turn in binder
29 Implicit diff, (odds) POW- study group picture Journal	30 Related rates skit, notes (1-25 odds, 26)	31 Finish	September 1	2 Straight line motion (odds)
5 <i>Labor Day Holiday</i> 	6 Finish POW journal	7 Rolle's thm. And mean value thm.	8	9 Celebration up to related rates
12 Function analysis POW journal	13 Finish	14 Finding absolute extreme	15	16 Approximate using diff.
20 Optimization POW journal	21 Optimization finish (all)	22 Indefinite integration	23	24 Fiesta up To Mean Value Thm.
26 slope fields POW Journal	27 U-Sub	28 Sigma Notation	29 Fall Holiday 	30 Area Under Curve

NOTE:

# AP<sup>®</sup> Instructional Planning Report – By Section (2011)

Print / Download Options

✓ Data Updated Jul 8, 2011, Report Run Jul 9, 2011

Westside High School (443522) - Calculus BC – Section Not Designated

## Performance on Multiple-Choice Section (Maximum Possible Score = 54)

Content Area	Number of Questions	Global Mean	Group Mean	Number of Students in Your Group			
				Lowest Fourth	Second Fourth	Third Fourth	Highest Fourth
CALCULUS AB TOPICS	27	17.2	18.2	1.058 6	9	17	8
CALCULUS BC-ONLY TOPICS	18	11.2	10.5	1.937 11	15	5	9
DIFFERENTIAL CALCULUS	21	13.1	14.1	1.076 8	7	15	10
INTEGRAL CALCULUS	16	11.5	11.6	1.009 10	14	7	9
PART A-NO CALCULATOR	28	18.4	18.3	1.995 9	11	15	5
PART B-WITH GRAPHING CALCULATOR	17	10.0	10.5	1.05 6	11	13	10
SERIES ITEMS	8	3.7	3.1	1.838 16	12	8	4
CALCULATOR ACTIVE ITEMS	5	3.3	3.2	1.69 9	12	17	2
<b>Multiple-Choice Summary</b>		<b>34.1</b>	<b>34.5</b>	<b>9</b>	<b>10</b>	<b>15</b>	<b>6</b>

## Performance on Free-Response Section (Maximum Possible Score = 54)

Question/Problem	Max Possible Score	Global Mean	Group Mean	Number of Students in Your Group			
				Lowest Fourth	Second Fourth	Third Fourth	Highest Fourth
PARAMETRIC PARTICLE MOTION	9	5.2	4.9	1.942 11	13	10	6
MODEL NUMERICALLY/ANALYTICALLY-AB & BC	9	5.5	6.0	1.091 6	11	10	13
PERIMETER/VOLUME	9	5.5	5.6	1.018 12	7	9	12
GRAPHICAL ANALYSIS OF F/FTC/MVT-AB & BC	9	4.1	4.4	1.073 12	6	7	15
MODELING WITH DIFF EQ-AB & BC	9	3.5	3.1	1.886 10	13	10	7
TAYLOR SERIES	9	4.0	4.1	1.625 8	8	16	8
<b>Free-Response Summary</b>		<b>27.9</b>	<b>28.1</b>	<b>8</b>	<b>11</b>	<b>12</b>	<b>9</b>

## indicates that the distribution is not displayed because more than half of the total AP global group earned the same score.

### Interpreting this report

The following columns appear in each table: Number of Questions (Multiple Choice table only), Max Possible (Free Response table only), Global Mean and Group Mean. The Global Mean column provides all AP students' average scores on specific content areas; the Group Mean column provides this information for your students. The right side of each table, Number of Students in Group, shows the number of your students that fell into the fourths. Fourth's are derived from dividing the total student population equally into four parts based on their performance in each content area. The numbers in the Number of Questions column for the multiple-choice content areas are simply the maximum possible scores. Beginning in 2011, no points will be deducted for incorrect answers to multiple-choice questions. The mean score for the content areas will be the average number of multiple choice questions answered correctly.

Some AP Exams have free-response questions that allow students to choose between topics; mean scores are not provided for those questions/problems of the exam. This is because the populations of AP students choosing each question when choice is permitted can be quite different.



## CALCULUS MANUAL

You are going to create a reference manual for the topics we have studied in Calculus with a table of contents and each entry containing the following:

1. On a numbered page, write the topic as a title.
2. **State any relevant definition or theorem.**
3. State the specific problem(s) that necessitate the use of the theorem or procedure under the general topic. (Find your own examples from homework problems – do NOT use problems from the class notes or the book!)
4. Working in two columns on the page, number each step in the symbolic form of the solution in the left-hand column and then write, **in your own words** (use language YOU understand), the procedure used in each step in the right-hand column.
5. The finished product must have a TABLE OF CONTENTS, with page numbers, so I recommend that you maintain it as you create your manual. Remember that the goal is for your finished product to be a “reference book” in times of need in future courses, so create it with this in mind, with the idea that you will bind it in some way.
6. Please note: I may add some entry types during the course of the year.

### Calculus Entries:

1. How to solve an absolute value inequality 2 ways (“and” & “or”).
2. How to graph the basic transformations of a function.
3. How the graphs of a function for which the limit as  $x \rightarrow a$  would not exist could look. Use at least three different possibilities.
4. How to prove that a function is continuous at a point.
5. How to prove that a function is continuous on a closed interval. (Include a piecewise function in your examples.)
6. How the graphs of functions that fail each part of the continuity definition could look. Use three examples. (Include Removable and Non-removable Discontinuity)
7. How to implement the Intermediate Value Theorem.
8. How to use the Definition of the Derivative and its Alternate Form to differentiate.
9. How to differentiate polynomial and rational functions, using Basic, Product, Quotient and Chain Rules.
10. How to relate continuity and differentiability.
11. How to find an equation of a line tangent and normal to a graph. (Use the quick way for finding the derivative.)
12. How to implement the Mean Value Theorem for Derivatives. Illustrate graphically.
13. How to use the First Derivative Test to graph a function.
14. How to find local extrema using the Second Derivative Test.
15. How to find absolute extrema on a closed interval.
16. How to differentiate implicitly, with an explanation of the need for this differentiation method.
17. How to solve related rate problems (3 types).
18. How to graph a function of  $f(x)$  given the graphs of  $f'(x)$  and  $f''(x)$ .
19. How to graph a function of  $f(x)$  given information in a chart about  $f'(x)$  and  $f''(x)$ :  $f(x)$  must be two types: 1 polynomial function and 1 rational function.
20. How to solve an optimization problem. (Max./Min.)
21. How to interpret differential equations geometrically using slope fields and their relationship to derivatives of implicitly defined functions.
22. How to compute the Riemann Sum over four equal subintervals for  $y = x^2 + 4$  on the interval  $[0, 8]$  using left and right endpoints and midpoints.

5) If the second derivative of  $f$  is given by  $f''(x) = 2x - \cos x$ , which of the following could be  $f(x)$ ?

- (A)  $\frac{x^3}{3} + \cos x - x + 1$
- (B)  $\frac{x^3}{3} - \cos x - x + 1$
- (C)  $x^3 + \cos x - x + 1$
- (D)  $x^2 - \sin x + 1$
- (E)  $x^2 + \sin x + 1$

6) If  $f$  is a function such that  $f'(x)$  exists for all  $x$  and  $f(x) > 0$  for all  $x$ , which of the following is NOT necessarily true?

- (A)  $\int_{-1}^1 f(x) dx > 0$
- (B)  $\int_{-1}^1 2f(x) dx = 2 \int_{-1}^1 f(x) dx$
- (C)  $\int_{-1}^1 f(x) dx = 2 \int_0^1 f(x) dx$
- (D)  $\int_{-1}^1 f(x) dx = - \int_1^{-1} f(x) dx$
- (E)  $\int_{-1}^1 f(x) dx = \int_{-1}^0 f(x) dx + \int_0^1 f(x) dx$

7)  $\int_0^{\frac{\pi}{2}} \frac{\cos \theta}{\sqrt{1 + \sin \theta}} d\theta =$

- (A)  $-2(\sqrt{2} - 1)$
- (B)  $-2\sqrt{2}$
- (C)  $2\sqrt{2}$
- (D)  $2(\sqrt{2} - 1)$
- (E)  $2(\sqrt{2} + 1)$

8)  $\int_0^1 x(x^2 + 2)^2 dx =$

- (A)  $\frac{19}{2}$
- (B)  $\frac{19}{3}$
- (C)  $\frac{9}{2}$
- (D)  $\frac{19}{6}$
- (E)  $\frac{1}{6}$

9) What is the average value of  $y$  for the part of the curve  $y = 3x - x^2$  which is in the first quadrant?

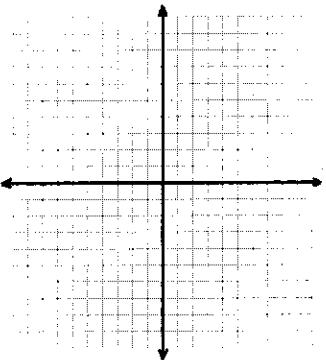
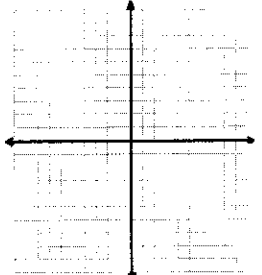
- (A)  $-6$
- (B)  $-2$
- (C)  $\frac{3}{2}$
- (D)  $\frac{9}{4}$
- (E)  $\frac{9}{2}$

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Stuff You Must Know Cold – Algebra 1

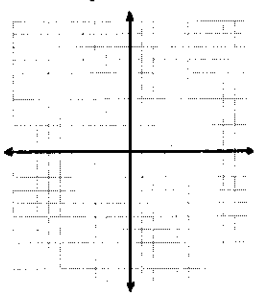
<p><b>Powers</b></p> <p><math>13^2 =</math>  <math>14^2 =</math>  <math>15^2 =</math>  <math>16^2 =</math>  <math>17^2 =</math>  <math>18^2 =</math>  <math>19^2 =</math>  <math>20^2 =</math>  <math>21^2 =</math>  <math>22^2 =</math>  <math>23^2 =</math>  <math>24^2 =</math>  <math>25^2 =</math>  <math>2^3 =</math>  <math>3^3 =</math>  <math>4^3 =</math>  <math>5^3 =</math>  <math>6^3 =</math>  <math>7^3 =</math>  <math>8^3 =</math>  <math>9^3 =</math>  <math>10^3 =</math>  <math>11^3 =</math>  <math>12^3 =</math>  <math>2^4 =</math>  <math>3^4 =</math>  <math>4^4 =</math>  <math>5^4 =</math></p>	<p><b>Powers</b></p> <p><math>2^5 =</math>  <math>3^5 =</math>  <math>4^5 =</math>  <math>5^5 =</math>  <math>2^6 =</math>  <math>2^7 =</math>  <math>2^8 =</math>  <math>2^9 =</math>  <math>2^{10} =</math>  <math>2^{11} =</math>  <math>2^{12} =</math></p>	<p><b>Quadratic Equations</b></p> <p>Parent Function:  General Form:  Standard Form:  Intercept Form:  Vertex:  Axis of Symmetry:  Quadratic Formula:</p>
<p><b>Fractions</b></p> <p><b>Integers</b></p>	<p><b>Factorials</b></p> <p><math>0! =</math>  <math>1! =</math>  <math>2! =</math>  <math>3! =</math>  <math>4! =</math>  <math>5! =</math>  <math>6! =</math>  <math>7! =</math></p>	<p>Graph <math>y =</math></p>  <p>label 3 points</p>
	<p><b>Linear Equations</b></p> <p>Parent Function:  Standard Form:  Slope-Intercept Form:  Point-Slope Form:  Slope:</p> <p>Graph <math>y =</math></p>  <p>label 3 points</p>	<p><b>Inequality Meanings</b></p> <p><math>&lt;</math>  <math>\leq</math>  <math>&gt;</math>  <math>\geq</math></p> <p><b>Three ways to solve a system of equations</b></p> <ol style="list-style-type: none"> <li>1.</li> <li>2.</li> <li>3.</li> </ol>

Name:

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Stuff You Must Know Cold – Algebra 1

<p><b>Order of Operations</b></p> <ol style="list-style-type: none"> <li>1.</li> <li>2.</li> <li>3.</li> <li>4.</li> </ol> <p><b>Absolute Value</b>  <math>a \geq 0</math></p> <p><math> a  =</math></p> <p><math> -a  =</math></p> <p><b>Function Definitions</b></p> <p>Domain:</p> <p>Range:</p> <p>Function:</p>	<p><b>Properties</b> (use a, b, c)</p> <p>Commutative Addition:</p> <p>Multiplication:</p> <p>Associative Addition:</p> <p>Multiplication:</p> <p>Distributive:</p> <p><b>Measures of Central Tendency</b></p> <p>Mean:</p> <p>Median:</p> <p>Mode:</p> <p>Range:</p>	<p><b>Distance Formula</b> (between two points)</p> <p><math>d =</math></p> <p><b>Midpoint Formula</b></p> <p><math>(m_1, m_2) =</math></p> <p><b>Parallel and Perpendicular Lines</b></p> <p>If <math>y = mx + b</math></p> <p>Parallel line slope:</p> <p>Perpendicular line slope:</p> <p><b>Dimensional Analysis</b>  <math>(^{\circ}C \Leftrightarrow ^{\circ}F, in \Leftrightarrow cm, ft \Leftrightarrow mi, etc.)</math>  Convert</p>
<p>Direct Variation:</p> <p>Indirect Variation:</p> <p>Roots:</p> <p><b>Distance Formula</b> (physics)</p> <p><b>Pythagorean Theorem</b></p>	<p><b>Piecewise Graph</b></p> <p><math>f(x) = \left\{ \right.</math></p>  <p>label 3 points</p>	<p><b>Solve The System</b></p> <p><math>x =</math></p> <p><math>y =</math></p> <p><b>Discriminant Formula:</b></p> <p>Nature of roots:</p> <p><math>&gt; 0</math></p> <p><math>&lt; 0</math></p> <p><math>= 0</math></p>

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Stuff You Must Know Cold – Geometry

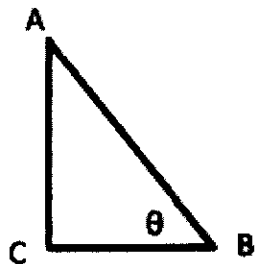
**Pythagorean Theorem:**

**Trigonometry:**

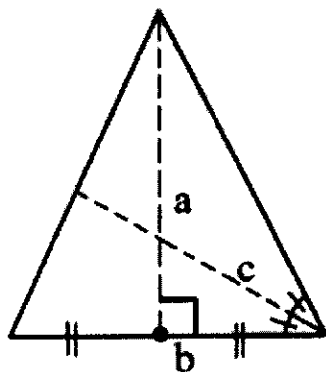
$\sin \theta =$

$\cos \theta =$

$\tan \theta =$



**Parts of a Triangle:**



- a:
- b:
- c:

**Similarity**

Ratio of sides a:b

Ratio of perimeters

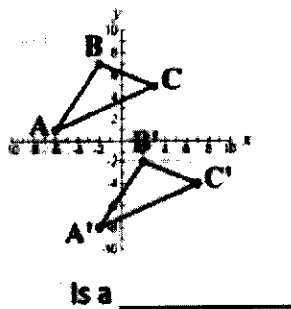
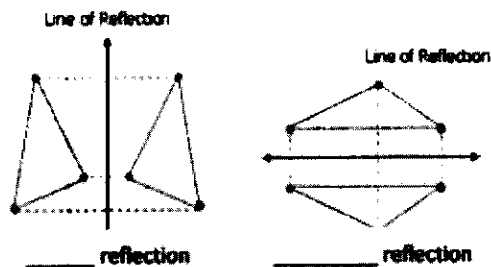
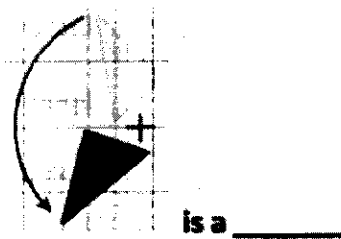
Ratio of areas

Ratio of volumes

**Triangle Congruence:**

- 1.
- 2.
- 3.
- 4.
- 5.

**Transformations:**



**Logic**

Conditional Statement:

Converse:

Inverse:

Contrapositive:

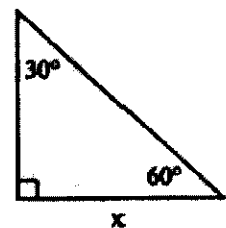
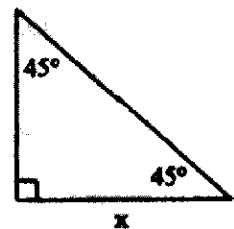
**Perimeter Formulas:**

Square:

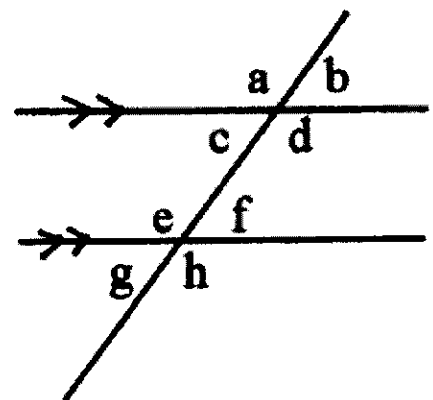
Rectangle:

Circumference of a Circle:

**Special Right Triangles:**



**Parallel Lines:**



a is congruent to:

a is supplementary to:

Name:

Date:

Number:

Stuff You Must Know Cold – Geometry

**Area Formulas:**

Square:

Rectangle:

Parallelogram:

Trapezoid:

Circle:

Right Triangle:

Any Triangle (Heron's Formula):

Equilateral Triangle:

Regular Polygon:


**Surface Area Formulas:**


Cube:

Sphere:

Cylinder:

**Angles:**

 is an \_\_\_\_\_ angle

 is an \_\_\_\_\_ angle

Complementary angles add up to \_\_\_\_\_

Supplementary angles add up to \_\_\_\_\_

**Volume Formulas:**

Cube:

Prism:

Cylinder:

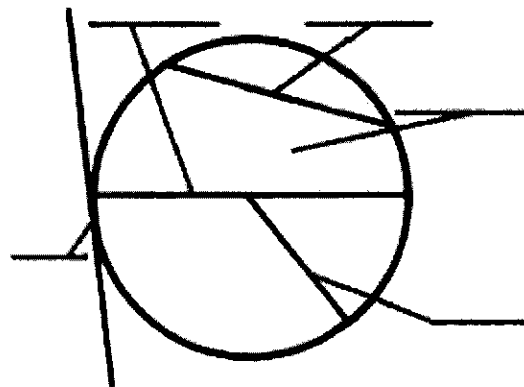
Pyramid:

Cone:

Sphere:

Volume is measured in \_\_\_\_\_ units

**Parts of a Circle:**



**Polygon Interior Angle Sums:**

Triangle:

Quadrilateral:

Regular Polygon:

**Arc and Sector**

Arc Length:

Sector Area:

**Roots to Know:**

$\sqrt{2} \approx$

$\sqrt{3} \approx$

**Polygon Names:**

Sides: Name:

3

4

5

6

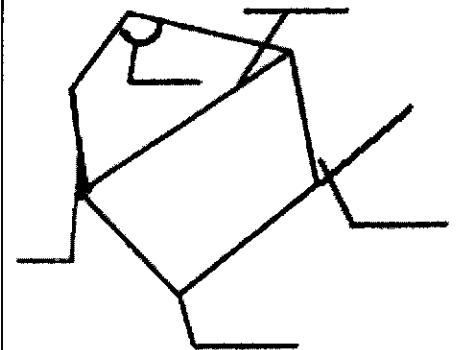
7

8

9

10

**Polygon Parts:**



**Lines:**

 is a \_\_\_\_\_

 is a \_\_\_\_\_

 = \_\_\_\_\_

$Y = 2/3x + 4$

Give a equation of a line

Parallel:

Give a line Perpendicular:

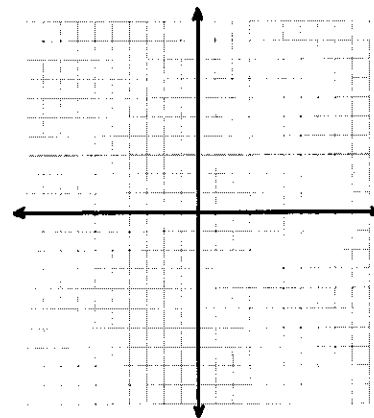
Name:

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## Stuff You Must Know Cold – Algebra II

<b>Arithmetic Series</b>	<b>Fractions</b>	<b>Arithmetic Operations</b>
$t_n =$	$\frac{0}{\#} =$	$ab + ac =$
$S_n =$	$\frac{0}{0} =$	$\frac{a}{b} + \frac{c}{d} =$
	$\frac{\#}{0} =$	$\frac{a+b}{c} =$
<b>Geometric Series</b>		$\left(\frac{a}{b}\right) =$
$t_n =$		$\left(\frac{c}{d}\right) =$
$S_n =$	<b>Conjugate</b> of $a + b$ is _____	$\left(\frac{a}{b}\right) =$
$S$	$(a-b)(a+b) =$	$\frac{a}{\left(\frac{b}{c}\right)} =$
		$\frac{a-b}{c-d} = \frac{b-a}{b-a}$
<b>Probability and Statistics</b>	<b>Horizontal Asymptote Rules:</b>	$a\left(\frac{b}{c}\right) =$
${}_n P_r =$	$y = \frac{ax^m + \dots}{bx^n + \dots}$	$\frac{a-b}{c-d} = \frac{b-a}{b-a}$
${}_n C_r = \left(\frac{n}{r}\right) =$	<ol style="list-style-type: none"> <li>1.</li> </ol>	$\frac{ab+ac}{a} =$
	<ol style="list-style-type: none"> <li>2.</li> </ol>	
	<ol style="list-style-type: none"> <li>3.</li> </ol>	
<b>Transformations (a,b,h,k &gt; 0)</b>		<b>Parent Functions</b>
$y = f(x) - k$		<b>Graph</b> $y =$
$y = f(x - h)$		
$y = -f(x)$		
$y = f(-x)$		
$y = f^{-1}(x)$		
$y = cf(x)$		
$y = f(bx)$		
	<b>Imaginary Numbers:</b>	
	$\sqrt{-1} =$	
	$i^2 =$	
	$i^3 =$	
	$i^4 =$	



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## Stuff You Must Know Cold – Algebra II

Exponents and Radicals	Logarithm Rules	Conics (standard forms)
$a^0 = 1, a \neq 0$ $(ab)^n =$ $a^x a^y =$ $\sqrt{a} =$ $\frac{a^x}{a^y} =$ $\sqrt[n]{a} =$ $\left(\frac{a}{b}\right)^x =$ $\sqrt[n]{a^m} =$ $a^{-x} =$ $\sqrt[n]{ab} =$ $(a^x)^y =$ $\sqrt[n]{\frac{a}{b}} =$	Change from log to exponential $\log_b y = x$  $\ln y = x$  $\log y = x$  Change from exponential to log $b^x = y$  More log rules $\log_a a =$  $\log_a 1 =$  $\log_a a^n =$  $\log_b (mn) =$  $\log_b \left(\frac{m}{n}\right) =$  $\log_b m^n =$	Circle:  Parabola Vertical:  Horizontal:  Ellipse Vertical:  Horizontal:  Hyperbola Vertical:  Horizontal:  Complete the Square:
<b>Interest/Half-Life</b>  Compound Interest:  Continuously Compounded:  Exponential Growth/Decay:	Change of base formula $\log_c a =$  <b>Intercepts</b>  To find the x-intercept of any function:  To find the y-intercept of any function:	<b>Factoring</b>  Difference of Squares $a^2 - b^2 =$  Difference of Cubes $a^3 - b^3 =$  Sum of Cubes $a^3 + b^3 =$  Perfect Square Trinomial $a^2 - 2ab + b^2 =$  $a^2 + 2ab + b^2 =$  Grouping $ac + ad + bc + bd =$

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### Stuff You Must Know Cold – Pre-Cal

#### Even – Odd Functions

If  $f(x)$  is even, then

If  $f(x)$  is odd, then

#### Composite Functions

$f(x) =$

$g(x) =$

$f(g(x)) =$

#### Triangles

Law of Cosines:

Law of Sines:

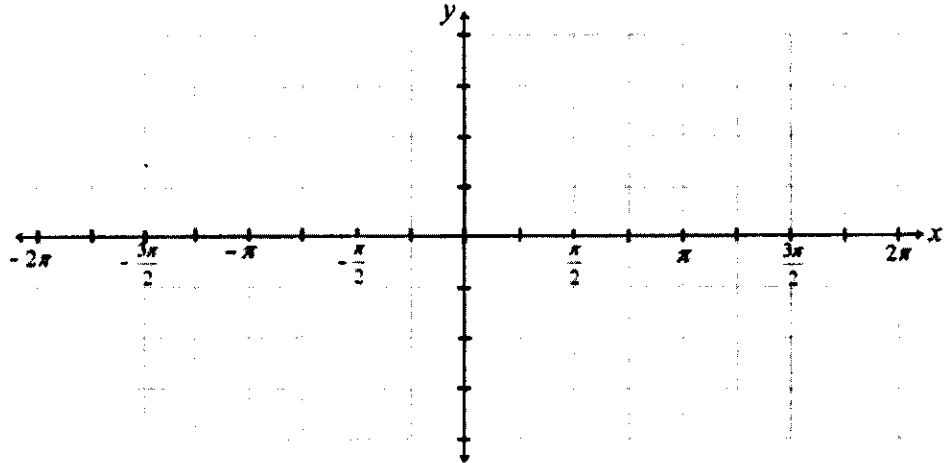
#### Values of Trigonometric Functions for Common Angles

$\theta$	$\sin \theta$	$\cos \theta$	$\tan \theta$
$0^\circ$			
$\frac{\pi}{6}$			
$\frac{\pi}{4}$			
$\frac{\pi}{3}$			
$\frac{\pi}{2}$			
$\pi$			

Know both the *inverse trig* and the *trig* values. E.g.  $\tan^{-1}(1)$

#### Trig Graph

$y =$

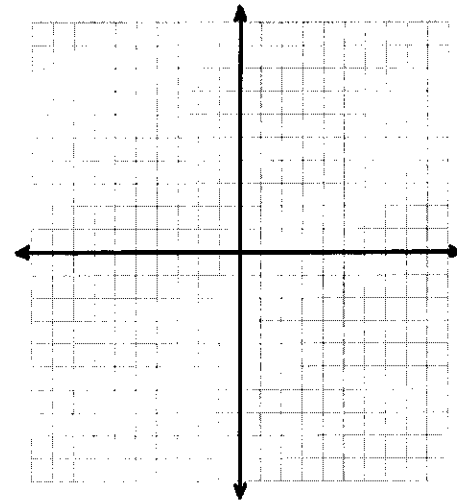


#### Parametric Equations

Graph

$x(t) =$

$y(t) =$



#### Polar Equations

Standard Formulas

$x =$

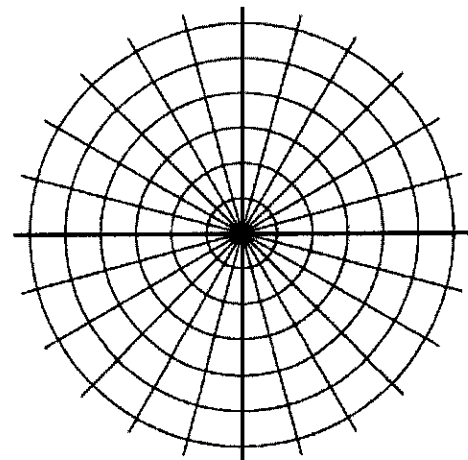
$y =$

$\tan \theta =$

$x^2 + y^2 =$

Graph

$r =$



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Date:

Number:

Stuff You Must Know Cold – Pre-Cal

**Trig Identities**

Double Angle

$\sin(2x) =$

$\cos(2x) =$

$=$

$=$

Power Reduction

$\sin^2 x =$

$\cos^2 x =$

Pythagorean

$\sin^2 x + \cos^2 x =$

$1 + \tan^2 x =$

$\cot^2 x + 1 =$

Reciprocal

$\sec x =$

$\cos x \cdot \sec x =$

$\csc x =$

$\sin x \cdot \csc x =$

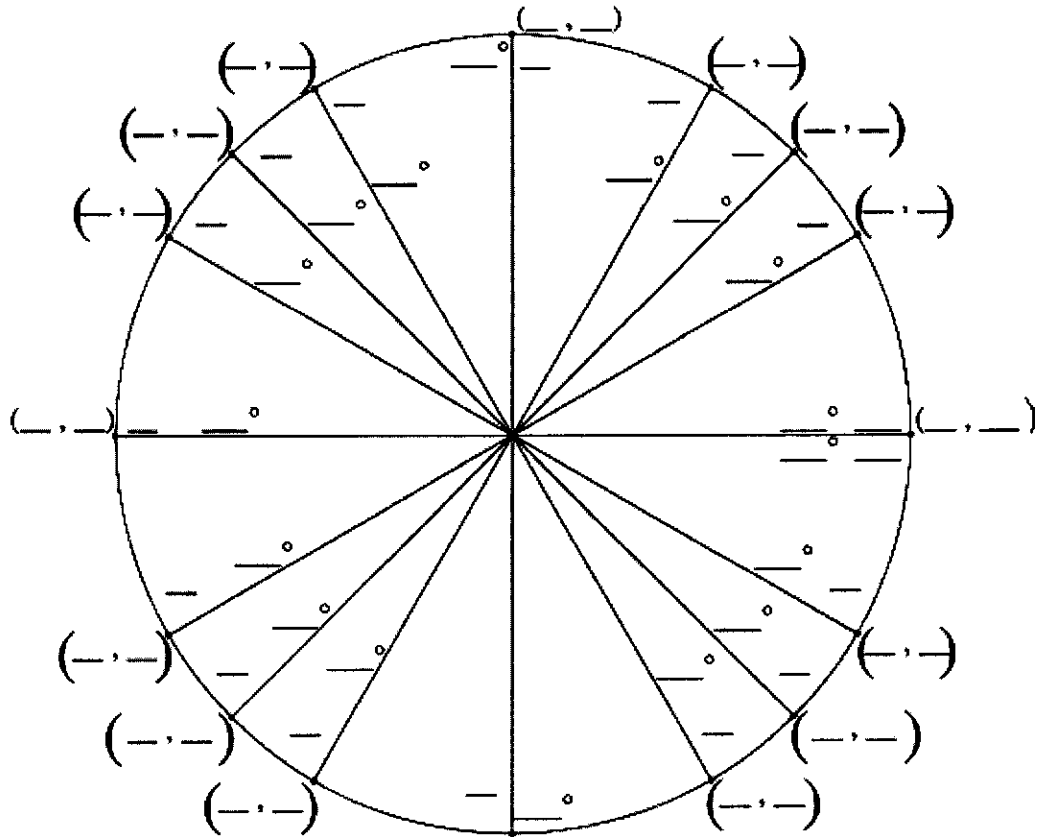
Even/Odd

$\sin(-x) =$

$\cos(-x) =$

$\tan(-x) =$

**Trig Unit Circle**

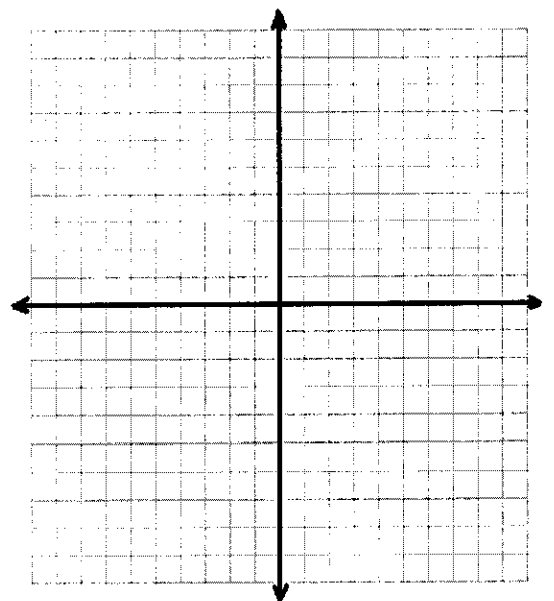


**Vectors**

$\vec{u} = \langle \quad , \quad \rangle$

$\|\vec{u}\| =$

Graph  $\vec{u}$





Name:

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## Stuff You Must Know Cold – Cal AB/BC

<p><b>Limits</b> Notation for: Limit from the left of <math>f(x)</math> as <math>x \rightarrow a</math></p> <p>Limit from the right of <math>f(x)</math> as <math>x \rightarrow a</math></p> <p>Theorems: <math>\lim_{x \rightarrow a} f(x) = F</math> and <math>\lim_{x \rightarrow a} g(x) = G</math> <math>\lim_{x \rightarrow a} (f(x) + g(x)) =</math></p> <p><math>\lim_{x \rightarrow a} (f(x) - g(x)) =</math></p> <p><math>\lim_{x \rightarrow a} (f(x) \cdot g(x)) =</math></p> <p><math>\lim_{x \rightarrow a} (f(x))^n =</math></p> <p><math>\lim_{x \rightarrow a} \frac{f(x)}{g(x)} =</math></p> <p><math>\lim_{x \rightarrow 0} \frac{\sin x}{x} =</math></p> <p><math>\lim_{x \rightarrow 0} \frac{1 - \cos x}{x} =</math></p> <p><b>Definition of Continuity:</b> A function is continuous at the point <math>x=a</math> if and only if:</p> <ol style="list-style-type: none"> <li></li> <li></li> <li></li> </ol> <p><b>Extreme Value Theorem</b></p>	<p><b>Curve Sketching and Analysis</b></p> <p>Critical Points:</p> <p>Global Min:</p> <p>Global Max:</p> <p>Point of Inflection:</p> <p><b>Derivatives</b></p> <p>Definition of Derivative <math>\frac{d}{dx}(f(x)) =</math></p> <p>Alternate Form of Def. of Derivative <math>\frac{d}{dx}(f(x))</math> at <math>x = a</math></p> <p>Chain Rule <math>\frac{d}{dx}[f(u)] =</math></p> <p>Product Rule <math>\frac{d}{dx}(uv) =</math></p> <p>Quotient Rule <math>\frac{d}{dx}\left(\frac{u}{v}\right) =</math></p> <p>Where <math>u</math> and <math>v</math> are functions of <math>x</math></p>	<p><b>More Derivatives</b> Where <math>u</math> is a function of <math>x</math> and <math>a</math> is a constant</p> <p><math>\frac{d}{dx}(x^n) =</math></p> <p><math>\frac{d}{dx}(\sin u) =</math></p> <p><math>\frac{d}{dx}(\cos u) =</math></p> <p><math>\frac{d}{dx}(\tan u) =</math></p> <p><math>\frac{d}{dx}(\cot u) =</math></p> <p><math>\frac{d}{dx}(\sec u) =</math></p> <p><math>\frac{d}{dx}(\csc u) =</math></p> <p><math>\frac{d}{dx}(\ln u) =</math></p> <p><math>\frac{d}{dx}(e^u) =</math></p> <p><math>\frac{d}{dx}(\sin^{-1} u) =</math></p> <p><math>\frac{d}{dx}(\cos^{-1} u) =</math></p> <p><math>\frac{d}{dx}(\tan^{-1} u) =</math></p> <p><math>\frac{d}{dx}(\cot^{-1} u) =</math></p> <p><math>\frac{d}{dx}(a^u) =</math></p> <p><math>\frac{d}{dx}(\log_a u) =</math></p> <p><b>Intermediate Value Theorem</b></p>
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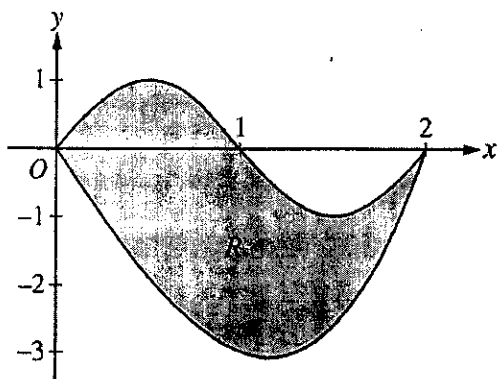
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## Stuff You Must Know Cold – Cal AB/BC

<p><b>The Mean Value Theorem</b> (derivatives)</p>	<p><b>Distance, Velocity, and Acceleration</b> <math>s(t)</math> is the position function, <math>\langle x(t), y(t) \rangle</math> is the position in parametric</p>	<p><b>Parametric Equations</b></p> $\frac{dy}{dx} =$
<p><b>Rolle's Theorem</b></p>	<p>velocity =</p>	$\frac{d^2y}{dx^2} =$
<p><b>The Fundamental Theorem of Calculus</b></p>	<p>acceleration =</p> <p>velocity vector =</p> <p>acceleration vector =</p>	<p><b>Polar Curves</b></p> <p>Area =</p> <p>Slope =</p>
<p><b>Corollary to FTC</b></p> $\frac{d}{dx} \int_a^{g(x)} f(t) dt =$	<p>speed (rectangular and parametric) =</p> <p>displacement =</p> <p>distance (rectangular and parametric) =</p>	<p><b>Taylor Series</b></p>
<p><b>Area Under The Curve (Trapezoids)</b></p>	<p>average velocity =</p>	<p><b>Maclaurin Series</b></p>
<p><b>Mean Value Theorem for Integrals (Average Value)</b></p>	<p><b>L'Hôpital's Rule</b> (Bernoulli's Rule)</p>	$e^x =$
<p><b>Solids of Revolution and Friends Disk Method</b></p>	<p><b>Euler's Method</b></p>	$\cos x =$
<p>Washer Method</p>	<p><b>Integration by Parts</b></p>	$\sin x =$
<p>General volume equation</p>	<p><b>Logistics</b></p> $\frac{dP}{dt} =$	$\frac{1}{1-x} =$
<p>Arc Length (rectangular)</p>	<p><b>Series Tests/Error Bound</b></p>	$\ln(x+1) =$

	AB1	AB2	AB3	AB4	AB5	AB6	BC	BC	BC
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Dixie Ross



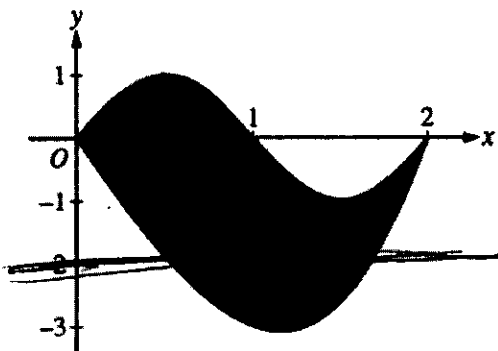
1. Let  $R$  be the region bounded by the graphs of  $y = \sin(\pi x)$  and  $y = x^3 - 4x$ , as shown in the figure above.
  - (a) Find the area of  $R$ .
  - (b) The horizontal line  $y = -2$  splits the region  $R$  into two parts. Write, but do not evaluate, an integral expression for the area of the part of  $R$  that is below this horizontal line.
  - (c) The region  $R$  is the base of a solid. For this solid, each cross section perpendicular to the  $x$ -axis is a square. Find the volume of this solid.
  - (d) The region  $R$  models the surface of a small pond. At all points in  $R$  at a distance  $x$  from the  $y$ -axis, the depth of the water is given by  $h(x) = 3 - x$ . Find the volume of water in the pond.

**CALCULUS BC**  
**SECTION II, Part A**

Time—45 minutes

Number of problems—3

A graphing calculator is required for some problems or parts of problems.



Work for problem 1(a)

$$\sin(\pi x) = x^3 - 4x$$

$$x = 2$$

$$A = \int_0^2 \sin(\pi x) - (x^3 - 4x) dx$$

$$A = 4$$

Work for problem 1(b)

$$-2 = x^3 - 4x$$

$$x = .5391887, \text{ and } 1.6751309$$

$$A = \int_{.5391887}^{1.6751309} (-2) - (x^3 - 4x) dx$$

$$= \int_{.5391887}^{1.6751309} -2 - x^3 + 4x dx$$

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Continue problem 1 on page 5

Work for problem 1(c)

$$V = \int_0^2 (\sin(\pi x) - (x^2 - 4x))^2 dx$$

$$V = 9.978344126$$

Work for problem 1(d)

$$V = \int_0^2 (\sin(\pi x) - (x^2 - 4x))(3 - x) dx$$

$$V = 8.369953106$$

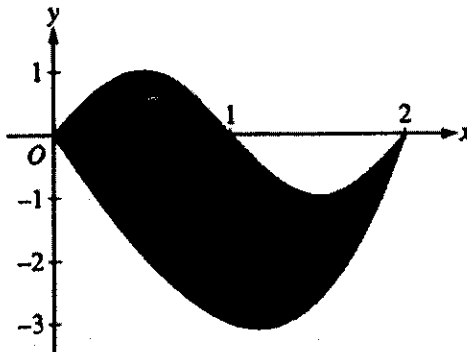
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**CALCULUS AB**  
**SECTION II, Part A**  
 Time—45 minutes  
 Number of problems—3

A graphing calculator is required for some problems or parts of problems.



Work for problem 1(a)

$$A = \int_0^2 (\sin(\pi x) - (x^3 - 4x)) dx$$

$$\int_0^2 (\sin(\pi x) - (x^3 - 4x)) dx = 4$$

$$\sin(\pi x) = x^3 - 4x$$

$$x = -2 \quad x = 0 \quad x = 2$$

Work for problem 1(b)

$$\sin(\pi x) - (x^3 - 4x)$$

$$y = -2$$

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

$$\int_0^2 ((\sin(\pi x) - x^3 + 4x) + 2) dx$$

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Continue problem 1 on page 5.

Work for problem 1(c)

cross section = square

$$A = s^2$$

$$= [\sin \pi x - x^3 + 4x]^2$$

$$V = \int_0^2 [\sin \pi x - x^3 + 4x]^2 dx = 9.9783$$

Work for problem 1(d)

$$h(x) = 3 - x \text{ (depth)}$$

$$V = \pi \int_0^2 [\sin \pi x - x^3 + 4x](3 - x) dx$$

$$26.2950$$

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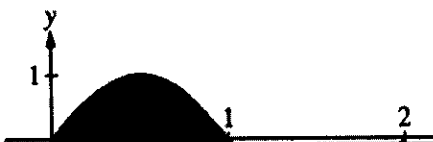
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**CALCULUS AB**  
**SECTION II, Part A**

**Time—45 minutes**

**Number of problems—3**

**A graphing calculator is required for some problems or parts of problems.**



Work for problem 1(c)

$$V_{\text{volume}} = \int_0^2 (\sin(\pi x))^2 - (x^3 - 4x)^2 = 8.752$$

Work for problem 1(d)

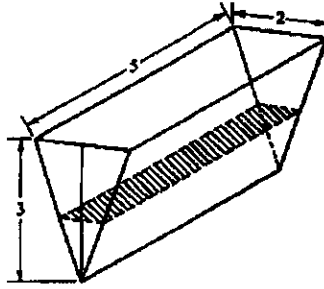
$$V_{\text{water pond}} = 4\pi \int_0^2 \frac{1}{2} (3-x)^2 dx = 17.333\pi$$

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1987 AB5



The trough shown in the figure above is 5 feet long, and its vertical cross sections are inverted isosceles triangles with base 2 feet and height 3 feet. Water is being siphoned out of the trough at the rate of 2 cubic feet per minute. At any time  $t$ , let  $h$  be the depth and  $V$  be the volume of water in the trough.

- Find the volume of water in the trough when it is full.
- What is the rate of change in  $h$  at the instant when the trough is  $\frac{1}{4}$  full by volume?
- What is the rate of change in the area of the surface of the water (shaded in the figure) at the instant when the trough is  $\frac{1}{4}$  full by volume?