**Harold’s AP Calculus BC**

**Cheat Sheet**

24 January 2025

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|  | **Rectangular** | **Polar** | | **Parametric** |
| **Point** | • | *or* | | *Point in Rectangular:*  *, variable, usually time,*  *with 1 degree of freedom (df)* |
| *Polar 🡪 Rect.* | *Rect. 🡪 Polar* |
| **Line** | *Slope-Intercept Form:*  *Point-Slope Form:*  *Intercept Form:*  *Normal Form:*  *Calculus Form:* | [http://upload.wikimedia.org/wikipedia/commons/thumb/7/78/Polar_to_cartesian.svg/250px-Polar_to_cartesian.svg.png](http://en.wikipedia.org/wiki/File:Polar_to_cartesian.svg) | | *where* |
| **Plane** | *Dot Product of Point-Normal Form:*  where:  *is orthogonal (perpendicular) to the plane*  *General Form:*  *Intercept Form:* | *Vector Form:* | | *Parametric Form:*  *where:*   * *is a point on the plane.* * *and  are direction vectors on the plane.* * *s and t are parameters that vary over all real numbers.* |
| **Conics** | *General Equation for All Conics:*  *where*  *or*  *Note: If , square hyperbola*  *Rotation:*  *If B ≠ 0, then* [*rotate*](http://faculty.eicc.edu/bwood/ma155supplemental/supplemental31.htm) *the coordinate system:*  *New = (x’, y’), Old = (x, y)*  *rotates through angle from x-axis*  http://www.sensorsmag.com/files/sensor/nodes/2009/6475/Figure9.gif | *General Equation for All Conics:*  *p = semi-latus rectum*  *or the line segment running from the focus to the curve in a direction parallel to the directrix*  *Eccentricity:*  Image result for conics | | Image result for conics  557px Conic Sections.svg |
| **Circle** | *Center:*  *Vertices: NA*  *Focus:*  Equation of a Circle | *Centered at Origin:*  *r = a (constant)*  *Centered at :*  *Hint: Law of Cosines*  *or*  Image result for off center circle in polar coordinates | | *Center:*  *Focus:* |
| **Ellipse** | *Center:*  *Vertices:*  *Co-Vertices:*  *Foci:*  *Focus length, c, from center:*  http://newportaoit.org/tfuentes/ellipse2.gif | *Ellipse:*  *relative to center*  Image result for conics  See the source image  ***Interesting Note:***  *The sum of the distances from each focus to a point on the curve is constant.* | | *Center:*  *Rotated Ellipse:*  *= the angle between the x-axis and the major axis of the ellipse*  http://www.sensorsmag.com/files/sensor/nodes/2009/6475/Figure9.gif |
| **Hyperbola** | *Center:*  *Vertices:*  *Foci:*  *Focus length, c, from center:*  Hyperbola  ***Interesting Note:***  *The difference between the distances from each focus to a point on the curve is constant.* | *Vertical Axis of Symmetry:*  *relative to center*  Image result for "latus rectum" of a hyperbola  *p = semi-latus rectum*  *or the line segment running from the focus to the curve in the directions* | | *Left-Right Opening Hyperbola:*  *Vertex: (h, k)*  *Up-Down Opening Hyperbola:*  *Vertex: (h, k)*  *General Form:*  *where A and D have different signs* |
| **Parabola** | *Vertical Axis of Symmetry:*  *Vertex:*  *Focus:*  *Directrix:*  *Horizontal Axis of Symmetry:*  *Vertex:*  *Focus:*  *Directrix:*  Parabola | *Vertical Axis of Symmetry:*  *and*  *Trigonometric Form:*    Image result for conics parabola rectum  ***Interesting Note:***  *The distances from a point on the curve to the focus is the same as to the directrix.* | | *Vertical Axis of Symmetry:*  *(opens upwards)*  *(opens downwards)*  *Vertex:*  *Horizontal Axis of Symmetry:*  *(opens to the right)*  *(opens to the left)*  *Vertex:*  *Projectile Motion:*  *feet*  *meters*  *General Form:*  *where A and D have the same sign* |

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| **1st Derivative** |  | *Hint: Use Product Rule for* | |  |
| **2nd Derivative** |  |  | |  |
| **Integral** | *Fundamental Theorem of Calculus:* | [http://upload.wikimedia.org/wikipedia/commons/thumb/2/2a/Riemann_sum_convergence.png/250px-Riemann_sum_convergence.png](http://en.wikipedia.org/wiki/File:Riemann_sum_convergence.png) | | *Riemann Sum:*  *Left Sum:*  *Middle Sum:*  *Right Sum:* |
| **Inverse Functions** | *Inverse Function Theorem:* | *if*  *if*  *if*  *if*  *if*  *if* |  | *or*  *or*  *or*  *or*  *or*  *or* |
| **Arc Length** | *Proof:* | *Circle:*  *Proof:*  http://www.mathwarehouse.com/trigonometry/radians/images/picture-s=r-theta-circle.gif | | *Proof:* |
| **Perimeter** | *Square:* *P = 4s*  *Rectangle:* *P = 2l + 2w*  *Triangle:* *P = a + b + c*  *Circle:* *C = πd = 2πr*  *Ellipse:* | *Ellipse:* | | *Ellipse:* |
| **Area** | *Square:* *A = s²*  *Rectangle:* *A = lw*  *Rhombus:* *A = ½ ab*  *Parallelogram:* *A = Bh*  *Trapezoid:*  *Kite:*  *Triangle:* *A = ½ Bh*  *Triangle:* *A = ½ ab sin(C)*  *Triangle using Heron’s Formula:*  *Equilateral Triangle:*  *Frustum:*  *Circle:* *A = πr²*  *Circular Sector:* *A = ½ r²*  *Ellipse:* *A = πab* | *where*  [http://upload.wikimedia.org/wikipedia/commons/thumb/4/4c/Polar_coordinates_integration_Riemann_sum.svg/220px-Polar_coordinates_integration_Riemann_sum.svg.png](http://en.wikipedia.org/wiki/File:Polar_coordinates_integration_Riemann_sum.svg)  *Area of a sector where arc length :* | | *where and*  *or*  *Simplified:*  *Proof:* |
| **Lateral Surface Area** | *Cylinder: SA = 2πrh*  *Cone: SA = πrl* | *For rotation about the x-axis:*  *For rotation about the y-axis:* | | *For rotation about the x-axis:*  *For rotation about the y-axis:* |
| **Total Surface Area** | *Cube:* *SA = 6s²*  *Rectangular Box:* *SA = 2lw + 2wh + 2hl*  *Regular Tetrahedron:* *SA = 2bh*  *Cylinder:* *SA = 2πr (r + h)*  *Cone:* *SA = πr² + πrl = πr (r + l)*  *Sphere:* *SA = 4πr²*  *Ellipsoid:* *SA*  *Where p*  *(Knud Thomsen’s Formula)* | | |  |
| **Surface of Revolution** | *For revolution about the x-axis:*  *For revolution about the y-axis:* | *For revolution about the x-axis:*  *For revolution about the y-axis:* | | *For revolution about the x-axis:*  *For revolution about the y-axis:* |
| **Volume** | *Cube:*  *Rectangular Prism:*  *Cylinder:*  *Triangular Prism:*  *Tetrahedron:*  *Pyramid:*  *Cone:*  *Sphere:*  *Ellipsoid:* | | | |
| **Volume of Revolution** | **Disk Method**  *Rotation about the x-axis:*  *Rotation about the y-axis:* | cochranmath / Volume of a solid of revolution by plane slicing | | |
| **Washer Method**  *Rotation about the x-axis:* |  | | |
| **Shell Method**  *Rotation about the y-axis:*  *Rotation about the x-axis:* | 2.3 Volumes of Revolution: Cylindrical Shells - Calculus Volume 2 ...  This figure has two images. The first is labeled “a” and is of a hollow cylinder around the y-axis. On the front of this cylinder is a vertical line labeled “cut line”. The height of the cylinder is “y=f(x)”. The second figure is labeled “b” and is a shaded rectangular block. The height of the rectangle is “f(x*), the width of the rectangle is “2pix*”, and the thickness of the rectangle is “delta x”. | | |