**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 | *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 conics557px 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 conicsSee 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 | *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*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”. |