

# Index

## A

absolute extremum, 103  
acceleration  
    normal component, 357  
    tangential component, 357  
acceleration vector, 357  
algebraic precedence, 517  
alternating harmonic series, 285  
anti-parallel vectors, 321  
antiderivative, 139  
arc length, 351  
arc length parameterization, 352  
arccosine, 197  
arcsine, 196  
asymptote, 23, 99  
average, 415  
average height, 395

## B

bell curve, 238  
binormal, 356, 448  
bounded function, 54

## C

cardioid, 254  
Cartesian coordinates, 253, 335  
Cauchy Principal Value, 232  
center of mass, 415  
center of mass, 227  
centroid, 228, 412

chain rule, 67  
characteristic polynomial, 479  
chord, 32  
circle  
    area, 517  
    circumference, 517  
    equation of, 21, 518  
    unit, 21  
Clairaut's Theorem, 383  
closed paths, 437  
completing the square, 517  
composition of functions, 27, 45, 67  
concave down, 98  
concave up, 98  
cone  
    lateral area, 518  
    surface area, 518  
    volume, 518  
conservative vector field, 436  
continuous, 55  
convergent sequence, 271  
convergent series, 276  
coordinates  
    Cartesian, 253, 335  
    converting rectangular to polar, 254  
    cylindrical, 335  
    polar, 253, 335  
    rectangular, 253, 335  
    spherical, 337  
cosines  
    law of, 319, 518  
critical value, 92  
cross product, 325

cumulative distribution function, 238  
 curvature, 354  
 curvature formula, 354, 355  
 cycloid, 263  
 cylinder  
   lateral area, 518  
   surface area, 518  
   volume, 518  
 cylindrical coordinates, 417  
 cylindrical coordinates, 335

**D**

definite integral, 143  
 $\text{del } (\nabla)$ , 379  
 dependent variable, 24  
 derivative, 34  
   dot notation, 116  
   Leibniz notation, 49  
 difference quotient, 32  
 differentiable, 55, 373  
 differential, 128  
 differential equation, 465  
   first order, 466  
   particular solution, 468  
   separable, 468  
 directional derivative, 379  
 discrete probability, 235  
 discriminant, 384  
 displacement vector, 314  
 divergence test, 278  
 Divergence Theorem, 460  
 divergent sequence, 271  
 divergent series, 276  
 domain, 23  
 dot notation, 116  
 dot product, 320  
 double integral, 397

**E**

ellipse  
   equation of, 518  
 ellipsoid, 251  
 error estimate, 219  
 escape velocity, 234  
 Euler's Method, 475  
 expected value, 236  
 exponential distribution, 239  
 Extreme Value Theorem, 105

**F**

Fermat's Theorem, 92

flux, 454  
 frustum, 247  
 Fubini's Theorem, 399  
 function, 22  
   bounded, 54  
   differentiable, 55  
   implicit, 82  
   linear, 22  
   of two variables, 368  
   rational, 213  
   unbounded, 54  
 function composition, 27  
 Fundamental Theorem of Algebra, 95  
 Fundamental Theorem of Calculus, 137

**G**

Gabriel's horn, 235, 250  
 geometric series, 276  
 global extremum, 103  
 gradient, 379  
 greatest integer, 94

**H**

harmonic series, 279  
   alternating, 285  
 Hooke's Law, 175  
 hyperbolic cosine, 199  
 hyperbolic sine, 199  
 hypercycloid, 264  
 hypocycloid, 264

**I**

implicit differentiation, 82, 377  
 implicit function, 82  
 improper integral, 231  
   convergent, 231  
   diverges, 231  
 incompressible, 447  
 indefinite integral, 143  
 independent variable, 24  
 inflection point, 98  
 initial condition, 466  
 initial value problem  
   first order, 466  
 integral  
   improper, 231  
   of  $\sec x$ , 209  
   of  $\sec^3 x$ , 209

properties of, 147  
 integral sign, 139  
 integral test, 282  
 integration  
     by parts, 210  
 Intermediate Value Theorem, 55  
 interval of convergence, 295  
 inverse sine, 196  
 involute, 264

**J**

Jacobian, 425  
 judicious guessing, 482

**K**

kinetic energy, 233

**L**

L'Hôpital's Rule, 87  
 Lagrange multipliers, 389  
 lateral area of a cone, 114  
 law of cosines, 319, 518  
 law of sines, 518  
 Leibniz notation, 49  
 level curve, 363  
 level set, 364  
 level surface, 364  
 limit, 41  
 limit at infinity, 87  
 limit of a sequence, 271  
 line integral, 431  
 linear approximation, 127  
 linearity of the derivative, 60  
 local extremum, 91  
 local maximum, 91  
 local minimum, 91  
 logistic equation, 470  
 long division of polynomials, 215

**M**

Maclaurin series, 299  
 mass, 415  
 mean, 236, 239  
 Mean Value Theorem, 130  
 moment, 227, 410, 416

**N**

Napier's constant, 187

Newton, 174  
 Newton's law of cooling, 465  
 normal, 329, 356  
 normal distribution, 243

**O**

one sided limit, 46  
 optimization, 103  
 orientable surface, 454  
 oriented curve, 439

**P**

*p*-series, 282  
 parallel vectors, 321  
 parallelogram  
     and vector sum, 315  
     area of, 327, 412, 424  
 parametric equations, 262, 332, 342  
 partial fractions, 213  
 particular solution, 468  
 physicists, 116  
 point-slope formula, 518  
 polar coordinates, 253, 335  
 polynomial  
     of two variables, 368  
 power function, 57  
 power rule, 57  
 precedence  
     of algebraic operations, 517  
 probability density function, 237  
 product rule, 62, 63  
     generalized, 64  
 projection, 433  
     scalar, 433  
 projection of a vector, 321  
 properties of integrals, 147

**Q**

quadratic formula, 517  
 quotient rule, 64

**R**

radian measure, 73  
 radius of convergence, 295  
 random variable, 236  
 rational function, 66, 213  
 rectangular coordinates, 253, 335  
 related rates, 115

resonant frequency, 486  
right hand rule, 328  
Rolle's Theorem, 130

***S***

scalar multiplication, 316  
scalar projection, 433  
separation of variables, 468  
sequence, 270  
  bounded, 274  
  bounded above, 274  
  bounded below, 274  
  convergent, 271  
  decreasing, 274  
  divergent, 271  
  increasing, 274  
  monotonic, 274  
  non-decreasing, 274  
  non-increasing, 274  
  of partial sums, 276  
series, 270  
   $p$ -series, 282  
  absolute convergence, 290  
  alternating harmonic, 285  
  conditional convergence, 290  
  convergent, 276  
  divergent, 276  
  geometric, 276  
  harmonic, 279  
  integral test, 282  
  interval of convergence, 295  
  Maclaurin, 299  
  radius of convergence, 295  
  Taylor, 302  
Simpson's Rule, 221  
sines  
  law of, 518  
slope field, 477  
sphere  
  surface area, 517  
  volume, 517  
spherical coordinates, 337, 417  
spiral of Archimedes, 255  
squeeze theorem, 77  
standard deviation, 241  
standard normal distribution, 239  
standard normal probability density  
  function, 238  
steady state part of solution to d.e., 484  
substitution, 421  
subtend, 74  
sum

of vectors, 315  
sum rule, 61  
surface area, 412

***T***

tangent line, 32  
Taylor series, 302  
Toricelli's trumpet, 235, 250  
torque, 225  
torus, 250  
transcendental function, 73  
transcendental number, 187  
transient part of solution to d.e., 484  
triangle inequality, 43, 314  
trigonometric identities, 518

***U***

unbounded function, 54  
undetermined coefficients, 482  
uniform distribution, 238  
uniform probability density function, 238  
unit normal, 356  
unit binormal, 356  
unit circle, 21  
unit vector, 322, 348

***V***

variance, 241  
variation of parameters, 473, 486  
vector, 314  
  anti-parallel, 321  
  cross product, 325  
  displacement, 314  
  function, 342  
  normal to a plane, 329  
  parallel, 321  
  projection, 321  
  scalar multiplication, 316  
  sum, 315  
  unit, 322  
vector fields, 429  
velocity, 37  
velocity vector, 357

***W***

witch of Agnesi, 66  
work, 173