

Index

A
absolute extremum, 119
acceleration
 normal component, 345
 tangential component, 345
acceleration vector, 345
algebraic precedence, 507
alternating harmonic series, 273
anti-parallel vectors, 309
antiderivative, 155
arc length, 232, 339
arc length parameterization, 340
arccosine, 96
arcsine, 94
area
 between curves, 191
 under a curve, 421
 under curve, 151
asymptote, 23, 115
average, 405
average height, 385

B
bell curve, 226
binormal, 344, 437
bounded function, 54

C
cardioid, 242
Cartesian coordinates, 241, 323

Cauchy Principal Value, 220
center of mass, 405
center of mass, 215
centroid, 216, 402
chain rule, 67
characteristic polynomial, 470
chord, 32
circle
 area, 507
 circumference, 507
 equation of, 21, 508
 unit, 21
Clairaut's Theorem, 372
closed paths, 427
completing the square, 507
composition of functions, 27, 45, 67
concave down, 114
concave up, 114
cone
 lateral area, 508
 surface area, 508
 volume, 508
conservative vector field, 426
continuous, 55, 355
convergent sequence, 259
convergent series, 264
coordinates
 Cartesian, 241, 323
 converting rectangular to polar, 242
 cylindrical, 323
 polar, 241, 323
 rectangular, 241, 323
 spherical, 325

511

Index 513

independent variable, 24
inflection point, 114
initial condition, 456
initial value problem
 first order, 456
integral
 improper, 219
 indefinite, 159
 of $\sec x$, 175
 of $\sec^3 x$, 175
 properties of, 163
integral sign, 155
integral test, 270
integration
 by parts, 176
Intermediate Value Theorem, 55
interval of convergence, 284
inverse function, 82
inverse sine, 94
involute, 252

J
Jacobian, 416
judicious guessing, 473

K
kinetic energy, 221

L
L'Hôpital's Rule, 98
Lagrange multipliers, 378
lateral area of a cone, 130
law of cosines, 307, 508
law of sines, 508
Leibniz notation, 49
level curve, 351
level set, 352
level surface, 352
limit, 41
limit at infinity, 98
limit of a sequence, 259
line integral, 421
linear approximation, 143
linearity of the derivative, 60
local extremum, 107
local maximum, 107
local minimum, 107
logarithm, 82
logarithmic function, 82

logistic equation, 460
long division of polynomials, 182

M
Maclaurin series, 288
mass, 405
mean, 224, 227
Mean Value Theorem, 146
moment, 215, 400, 406

N
Newton, 210
Newton's law of cooling, 455
Newton's method, 139–141
normal, 317, 344
normal distribution, 232

O
one sided limit, 46
optimization, 119
orientable surface, 444
oriented curve, 429

P
 p -series, 270
parallel vectors, 309
parallelogram
 and vector sum, 303
 area of, 315, 402, 414
parametric equations, 251, 320, 330
partial fractions, 180
particular solution, 458
physicists, 132
point-slope formula, 508
polar coordinates, 241, 323
polynomial
 of two variables, 356
power function, 57
power rule, 57, 89, 92
precedence
 of algebraic operations, 507
probability density function, 225
product rule, 62, 63
 generalized, 64
projection, 423
 scalar, 423
projection of a vector, 309
properties of integrals, 163

512 Index

cosines
 law of, 307, 508
critical value, 108
cross product, 313
cumulative distribution function, 226
curvature, 342
curvature formula, 342, 343
curve sketching, 107
cycloid, 251
cylinder
 lateral area, 508
 surface area, 508
 volume, 508
cylindrical coordinates, 407
cylindrical coordinates, 323

D

definite integral, 159
del (∇), 367
dependent variable, 24
derivative, 34, 48
 dot notation, 132
 Leibniz notation, 49
 second, 113
difference quotient, 32
differentiable, 55, 362
differential, 144
differential equation, 455
 first order, 456
 particular solution, 458
 separable, 458
directional derivative, 367
discrete probability, 223
discriminant, 373
displacement vector, 303
divergence test, 266
Divergence Theorem, 450
divergent sequence, 259
divergent series, 264
domain, 23
dot notation, 132
dot product, 308
double integral, 386

E

ellipse
 area, 507
 equation of, 508
ellipsoid, 239
error estimate, 185

escape velocity, 222
Euler's Method, 466
exp function, 85
expected value, 224
exponential distribution, 227
exponential function, 82
Extreme Value Theorem, 121

F

Fermat's Theorem, 108
flux, 443
frustum, 235
Fubini's Theorem, 389
function, 22
 bounded, 54
 differentiable, 55
 implicit, 90
 linear, 22
 of two variables, 356
 rational, 180
 unbounded, 54
function composition, 27
Fundamental Theorem of Algebra, 111
Fundamental Theorem of Calculus, 153

G

Gabriel's horn, 223, 238
geometric series, 264
global extremum, 119
gradient, 367
greatest integer, 110

H

harmonic series, 267
 alternating, 273
Hooke's Law, 211
hyperbolic cosine, 102
hyperbolic sine, 102
hypercycloid, 252
hypocycloid, 252

I

implicit differentiation, 89, 365
implicit function, 90
improper integral, 219
 convergent, 219
 diverges, 219
incompressible, 436
indefinite integral, 159

514 Index

Q

quadratic formula, 507
quotient rule, 64

R

radian measure, 73
radius of convergence, 284
random variable, 224
rational function, 66, 180
rectangular coordinates, 241, 323
related rates, 131
resonant frequency, 477
right hand rule, 316
Rolle's Theorem, 146

S

scalar multiplication, 304
scalar projection, 423
second derivative, 112, 113
separation of variables, 458
sequence, 258
 bounded, 262
 bounded above, 262
 bounded below, 262
 convergent, 259
 decreasing, 262
 divergent, 259
 increasing, 262
 monotonic, 262
 non-decreasing, 262
 non-increasing, 262
 of partial sums, 264
series, 258
 p -series, 270
 absolute convergence, 278
 alternating harmonic, 273
 conditional convergence, 278
 convergent, 264
 divergent, 264
 geometric, 267
 harmonic, 267
 integral test, 270
 interval of convergence, 284
 Maclaurin, 288
 radius of convergence, 284
 Taylor, 290
Simpson's Rule, 187
sines
 law of, 508
slope field, 468

sphere

 surface area, 508
 volume, 508

spherical coordinates, 325, 407
spiral of Archimedes, 243
squeeze theorem, 77
standard deviation, 229
standard normal distribution, 227
standard normal probability density function, 226
steady state part of solution to d.e., 476
substitution, 411
subtend, 74
sum
 of vectors, 303
sum rule, 61
surface area, 402

T
tangent line, 32
Taylor series, 290
Toricelli's trumpet, 223, 238
torque, 213
torus, 238
transcendental function, 73
transient part of solution to d.e., 476
Trapezoid Rule, 185
triangle inequality, 43, 302
trigonometric identities, 508

U

unbounded function, 54
undetermined coefficients, 473
uniform distribution, 226
uniform probability density function, 226
unit binormal, 344
unit circle, 21
unit normal, 344
unit vector, 310, 336

V

variance, 229
variation of parameters, 463, 477
vector, 302
 anti-parallel, 309
 cross product, 313
 displacement, 303
 function, 330
 normal to a plane, 317

parallel, 309
projection, 309
scalar multiplication, 304
sum, 303
unit, 310
vector fields, 419
velocity, 37
velocity vector, 345

W

witch of Agnesi, 66
work, 209