

Index

• Symbols and Numerics •

Ae^{rx} . See e^{rx}

e , raising both sides of equation to power of, 13, 16

e^{at} functions, Laplace transform of, 226

e^{rx}

$g(x)$ in the form of

for nonhomogeneous linear higher order equations, 153, 154–156

for nonhomogeneous linear second order equations, 105, 106–109

solution in the form $y = e^{rx}$

for homogeneous linear higher order equations, 129

for homogeneous linear second order equations, 86, 91

substituting $y = e^{rx}$ for $y = f(x)$, 85

ξ (eigenvector symbol), 258

$f(ct)$, Laplace transform of, 227

$f^{(n)}(t)$, Laplace transform of, 227

$f(x, y)$

explicit solution for, 64

implicit solution for, 63–64

as solution for exact first order equations, 59

solving exact first order equations for, 63–66

testing for exact first order equations, 59–62

$y = vx$ substitution suitability determined by, 35, 36

$g(x)$

in the form of e^{rx}

for nonhomogeneous linear higher order equations, 153, 154–156

for nonhomogeneous linear second order equations, 105, 106–109

involving sines and cosines

for nonhomogeneous linear higher order equations, 153, 159–161

for nonhomogeneous linear second order equations, 105, 112–114

as polynomial of order n

for nonhomogeneous linear higher order equations, 153, 157–159

for nonhomogeneous linear second order equations, 105, 109–112

i (imaginary number) in complex roots

homogeneous linear higher order equations, 133–135

homogeneous linear second order equations, 89–91

$\mu(x)$. See also integrating factors

identifying, for linear first order equations, 15–16

integrating factors as functions of, 15, 277

t^n functions, Laplace transform of, 226

y , y' , and y'' terms

linear versus nonlinear equations distinguished by, 7, 275

power series substitution for, 184

$y = e^{rx}$. See also characteristic equation

solution in the form of

for homogeneous linear higher order equations, 129

for homogeneous linear second order equations, 86, 91

substituting for $y = f(x)$, 85

$y = vx$ substitution

answers to problems, 47–51

for converting to separable equations, 35–38

general form suitable for, 35

$y = x^r$, solution for Euler's equation in form of, 206, 211

• A •

acceleration of falling object, 280

adding matrices, 249–250

Ae^{rx} . See e^{rx}

angle of pendulum equation, 7, 281

• C •

Calculus For Dummies (Ryan, Mark), 2

characteristic equation

defined, 86

for homogeneous linear higher order equations

answers to problems, 139–151

complex roots, 133–135

real and distinct roots, 130–133

real, identical roots, 135–138

Web-based equation solver for, 129

for homogeneous linear second order equations

answers to problems, 94–104

complex roots, 89–91

real and distinct roots, 86–89

real, identical roots, 91–93

types of solutions possible for, 87, 130

Web-based equation solver for, 129

circuits, electrical, 281–282

classifying singular points as regular or irregular, 203–205

coefficients

constant, for homogeneous linear higher order equations

answers to problems, 139–151

attempting solutions in the form

$y = e^{rx}$, 129

with complex roots, 133–135

with real and distinct roots, 130–133

with real, identical roots, 135–138

Web-based equation solver for, 129

constant, for homogeneous linear second order equations

answers to problems, 95–104

assuming solutions in the form $y = e^{rx}$, 86

characteristic equation, defined, 86

with complex roots, 89–91

guessing a solution, 84–86

with real and distinct roots, 86–89

with real, identical roots, 91–93

constant, Laplace transform kernel for equations with e^{-st} , 226

polynomial, in equations with regular singular points, 203

in power series, solving for, 184

undetermined, method for

nonhomogeneous linear higher order equations

answers to problems, 162–74

overview, 153

when $g(x)$ involves sines and cosines, 153, 159–161

when $g(x)$ is a polynomial of order n , 153, 157–159

when $g(x)$ is in the form of e^{rx} , 153, 154–156

undetermined, method for

nonhomogeneous linear second order equations

answers to problems, 115–127

overview, 105

when $g(x)$ involves sines and cosines, 105, 112–114

when $g(x)$ is in the form of e^{rx} , 105, 106–109

when $g(x)$ is a polynomial of order n , 105, 109–112

undetermined, Web resource for, 276

of y''

linear second order equations with, converting, 82

linear second order equations

without, 81

complex roots

of characteristic equation

for homogeneous linear higher order equations, 133–135

for homogeneous linear second order equations, 89–91

of Euler's equation (complex conjugates), 206

computer-based numerical methods, 278

constant coefficients. *See also*

undetermined coefficients, method of

e^{-st} , Laplace transform kernel for equations with, 226

for homogeneous linear higher order equations

answers to problems, 139–151

attempting solutions in the form
 $y = e^{rx}$, 129
 with complex roots, 133–135
 with real and distinct roots, 130–133
 with real, identical roots, 135–138
 Web-based equation solver for, 129
 for homogeneous linear second order
 equations
 answers to problems, 95–104
 assuming solutions in the form $y = e^{rx}$,
 86, 129
 characteristic equation, defined, 86, 129
 with complex roots, 89–91
 guessing a solution, 84–86
 with real and distinct roots, 86–89
 with real, identical roots, 91–93
 constants, functions as, 7, 9
 constants of integration
 for exact first order equations, 64
 for linear first order equations
 involving terms in y , 13
 not involving terms in y , 10, 11
 solutions using integrating factors, 15,
 16, 17
 for separable first order equations, 31,
 33, 36
 continuous functions, linear second order
 equations with, 81–93
 convergence of power series
 answers to problems, 188–189
 finite series defined by, 177
 ratio test for, 178–180
 converting
 to exact equations, using integrating
 factors, 277
 between forms of linear second order
 equations, 82
 implicit solutions to standard form, 34, 64
 to separable equations, using $y = vx$
 substitution trick, 35–38
 cooling, Newton's law of, 281
 cosines
 $g(x)$ involving
 in nonhomogeneous linear higher order
 equations, 153, 159–161
 in nonhomogeneous linear second order
 equations, 105, 112–114
 Laplace transforms of functions, 226–227

• D •

derivatives
 first, in simple linear first order
 equations, 9
 Laplace transforms of, calculating,
 229–230
 second, for $y = f(x)$ in second order
 equations, 85
 determinant of matrices, 253–254
 determining or identifying
 determinant of matrices, 253–254
 exact first order equations, 59–62
 finite power series, 177–180
 homogeneous linear second order
 equations, 82–84
 linear first order equations, 7–9
 $\mu(x)$, for linear first order equations, 15–16
 regular versus irregular singular points,
 203–205
 singular points, 199–202
 whether solution exists, 278
Differential Equations For Dummies
 (Holzner), 1, 2, 3, 92, 106, 212, 278

• E •

e , raising both sides of equation to power
 of, 13, 16
 e^{at} functions, Laplace transform of, 226
 eigenvalues of matrices
 overview, 255–257
 solving systems of differential equations
 using, 258–261
 eigenvectors of matrices
 overview, 255–257
 solving systems of differential equations
 using, 258
 symbol for (ξ), 258
 electrical circuits, 281–282
 e^{rx}
 $g(x)$ in the form of
 for nonhomogeneous linear higher order
 equations, 153, 154–156
 for nonhomogeneous linear second
 order equations, 105, 106–109

e^{rx} (continued)

- solution in the form $y = e^{rx}$
 - for homogeneous linear higher order equations, 129
 - for homogeneous linear second order equations, 86, 91
- substituting $y = e^{rx}$ for $y = f(x)$, 85

Euler's equation

- answers to problems, 215–223
- assuming solutions in the form $y = x^r$, 206–210, 211
- cases for roots of, 206
- computer-based numerical methods for, 278
- solving general differential equations with regular singular points using, 211–214

exact first order differential equations

- answers to problems, 67–77
- defined, 277
- explicit solution for $f(x, y)$, 64
- general form, 59, 276
- implicit solution for $f(x, y)$, 63–64
- integrating factors for converting to, 277
- solving for $f(x, y)$, 63–66
- test for identifying, 59–62
- Web resource for, 277

explicit solutions

- converting implicit solutions to, 34, 64
- defined, 33
- for exact first order equations, 64

• F •

falling objects equation, 280

$f(ct)$, Laplace transform of, 227

finite power series. *See also* power series

- defined, 177
- identifying, 177–180

first order differential equations

- determining whether solution exists, 278
- exact
 - answers to problems, 67–77
 - defined, 277
 - explicit solution for $f(x, y)$, 64
 - general form, 59, 276
 - identifying, test for, 59–62

implicit solution for $f(x, y)$, 63–64

integrating factors for converting to, 277

solving for $f(x, y)$, 63–66

test for identifying, 59–62

Web resource for, 277

linear

answers to problems, 19–27

defined, 7, 275

examples, 8

general form, involving terms in y , 7, 12

general form, not involving terms in y , 9

homogeneous, solving systems of, 258–261

identifying, 7–9

initial conditions with, 10–11, 15–17

integrating factors for solving, 15–18, 277

involving terms in y , 12–14

nonlinear versus, 7

not involving terms in y , 9–12

Web resource for, 275

nonlinear, 7, 30

separable

answers to problems, 43–57

converting to, using $y = vx$ substitution trick, 35–38

defined, 29, 275

examples, 29–31

general form, 30

implicit solutions to, 33–35

initial conditions with, 39–40

nonlinear, 30

practicing separation skills, 39–40

Web resource for, 276

systems of linear

adding matrices, 249–250

answers to problems, 262–271

determinant of matrices, 253–254

eigenvalues and eigenvectors of matrices, 255–257

multiplying matrices, 251–252

solving, 258–261

subtracting matrices, 249

fluid flow equation, 279–280

fluid mixing equation, 280

$f^{(n)}(t)$, Laplace transform of, 227

functions

- constants as, in general form equations, 7, 9
- continuous, linear second order equations with, 81–93
- Laplace transforms of (table), 226–227
- of $\mu(x)$, integrating factors as, 15, 277
- $f(x, y)$
 - explicit solution for, 64
 - implicit solution for, 63–64
- as solution for exact first order equations, 59
- solving exact first order equations for, 63–66
- testing for exact first order equations, 59–62
- $y = vx$ substitution suitability determined by, 35, 36

• G •

- general differential equations with regular singular points, solving, 211–214
- general forms
 - converting implicit solutions to standard form, 34
 - equations suitable for separation using $y = vx$ substitution trick, 35
 - exact first order differential equations, 59, 276
 - Laplace transform for integral, 226
 - linear first order differential equations
 - involving terms in y , 7, 12
 - not involving terms in y , 9
 - linear higher order equations, 129, 153
 - linear second order differential equations
 - with coefficient of y'' , 82
 - without coefficient of y'' , 81
 - nonhomogeneous linear higher order equations, 153
 - separable first order differential equations, 30
- $g(x)$
 - in the form of e^{rx}
 - for nonhomogeneous linear higher order equations, 153, 154–156
 - for nonhomogeneous linear second order equations, 105, 106–109

involving sines and cosines

- for nonhomogeneous linear higher order equations, 153, 159–161
- for nonhomogeneous linear second order equations, 105, 112–114
- as polynomial of order n
 - for nonhomogeneous linear higher order equations, 153, 157–159
 - for nonhomogeneous linear second order equations, 105, 109–112

• H •

- higher order differential equations
 - linear, general form, 129, 153
 - linear homogeneous
 - answers to problems, 139–151
 - attempting solutions in the form $y = e^{rx}$, 129
 - with complex roots, 133–135
 - with real and distinct roots, 130–133
 - with real, identical roots, 135–138
 - Web-based equation solver for, 129
 - linear nonhomogeneous
 - answers to problems, 162–174
 - general form, 153
 - method of undetermined coefficients, 153–161
 - when $g(x)$ involves sines and cosines, 153, 159–161
 - when $g(x)$ is in the form of e^{rx} , 153, 154–156
 - when $g(x)$ is a polynomial of order n , 153, 157–159
- Holzner, Steven (*Differential Equations For Dummies*), 1, 2, 3, 92, 106, 212, 278
- homogeneous differential equations
 - defined, 276
 - linear first order equation systems, solving, 258–261
 - linear higher order
 - answers to problems, 139–151
 - attempting solutions in the form $y = e^{rx}$, 129
 - with complex roots, 133–135
 - with real and distinct roots, 130–133
 - with real, identical roots, 135–138
 - Web-based equation solver for, 129

homogeneous differential equations (*continued*)
 linear second order
 answers to problems, 94–104
 with complex roots, 89–91
 constant coefficients for, 84–93
 defined, 82
 identifying, 82–84
 with real and distinct roots, 86–89
 with real, identical roots, 91–93
 Web resource for, 276

• **I** •

i (imaginary number) in complex roots
 homogeneous linear higher order equations, 133–135
 homogeneous linear second order equations, 89–91
 identical roots of characteristic equation
 for homogeneous linear higher order equations, 135–138
 for homogeneous linear second order equations, 91–93
 identifying or determining
 determinant of matrices, 253–254
 exact first order equations, 59–62
 finite power series, 177–180
 homogeneous linear second order equations, 82–84
 linear first order equations, 7–9
 $\mu(x)$, for linear first order equations, 15–16
 regular versus irregular singular points, 203–205
 singular points, 199–202
 whether solution exists, 278
 implicit solutions
 converting to standard form, 34, 64
 defined, 33
 for exact first order equations, 63–64
 for separable first order equations, 33–35
 index of power series, shifting
 answers to problems, 189–190
 overview, 181–183
 inductor-resistor circuits equation, 281–282

infinite power series, 177. *See also* power series
 integrating factors
 answers to problems, 23–27
 for converting to exact equations, 277
 as functions of $\mu(x)$, 15, 277
 idea behind, 15
 solving linear first order equations using, 15–18, 277
 Web resource for, 277
 Internet resources
 acceleration and velocity of falling object, 280
 computer-based numerical methods, 278
 determining whether solution exists, 278
 exact first order differential equations, 277
 fluid flow, 279–280
 homogeneous differential equations, 276
 inductor-resistor circuits, 281–282
 integrating factors, 277
 Laplace transforms, 278
 method of undetermined coefficients, 276
 mixing fluids, 280
 motion of mass on spring, 282
 Newton’s law of cooling, 281
 orthogonal trajectories, 280
 pendulum motion, 281
 population growth equation solutions, 279
 radioactive decay, 281
 separable differential equations, 276
 series solutions or power series, 277
 solving linear first order differential equations, 275
 Web-based equation solvers, 129
 inverting Laplace transforms, 226
 irregular singular points
 defined, 203
 equations unsolvable near, 199
 identifying, 203–205

• **K** •

kernel of Laplace transforms
 choosing, 226
 defined, 226
 e^{-st} , for equations with constant coefficients, 226

• **L** •

Laplace transforms

- answers to problems, 236–248
- calculating by hand, 226
- choosing kernel for, 226
- of common functions (table), 226–227
- of derivatives, calculating, 229–230
- finding for equations, 225–228
- general integral transform, 226
- inverting, 226
- kernel, defined, 226
- limits of integration for, 226
- overview, 225, 278
- solving equations using, 231–235
- symbol for, 225, 226
- Web resource for, 278

law of cooling, 281

limits of integration for Laplace transforms, 226

linear differential equations

- defined, 7, 275
- nonlinear equations versus, 7

linear first order differential equations

- answers to problems, 19–27
- defined, 7, 275
- examples, 8
- general form, involving terms in y , 7, 12
- general form, not involving terms in y , 9
- homogeneous, solving systems of, 258–261
- identifying, 7–9
- initial conditions with, 10–11, 15–17
- integrating factors for solving, 15–18, 277
- involving terms in y , solving, 12–14
- nonlinear equations versus, 7
- not involving terms in y , solving, 9–12
- systems of
 - adding matrices, 249–250
 - answers to problems, 262–271
 - determinant of matrices, 253–254
 - eigenvalues and eigenvectors of matrices, 255–257
 - multiplying matrices, 251–252
 - solving, 258–261
 - subtracting matrices, 249
- Web resource for, 275

linear higher order differential equations

- general form, 129, 153
- homogeneous
 - answers to problems, 139–151
 - attempting solutions in the form $y = e^{rx}$, 129
 - with complex roots, 133–135
 - with real and distinct roots, 130–133
 - with real, identical roots, 135–138
 - Web-based equation solver for, 129
- nonhomogeneous
 - answers to problems, 162–174
 - general form, 153
 - method of undetermined coefficients, 153–161
 - when $g(x)$ involves sines and cosines, 153, 159–161
 - when $g(x)$ is in the form of e^{rx} , 153, 154–156
 - when $g(x)$ is a polynomial of order n , 153, 157–159

linear second order differential equations

- converting between forms, 82
- general form, with coefficient of y'' , 82
- general form, without coefficient of y'' , 81
- homogeneous
 - answers to problems, 94–104
 - with complex roots, 89–91
 - constant coefficients for, 84–93
 - defined, 82
 - with real and distinct roots, 86–89
 - with real, identical roots, 91–93
- initial conditions with, 81
- nonhomogeneous
 - answers to problems, 115–127
 - defined, 82
 - method of undetermined coefficients, 105–114
 - when $g(x)$ involves sines and cosines, 105, 112–114
 - when $g(x)$ is in the form of e^{rx} , 105, 106–109
 - when $g(x)$ is a polynomial of order n , 105, 109–112
- where $p(x)$, $q(x)$, and $g(x)$ are continuous functions, 81–93

linked differential equations, 258. *See also* systems of linear first order differential equations

• **M** •

mass on spring, motion of, 282

matrices

adding, 249–250

answers to problems, 262–271

determinant of, 253–254

eigenvalues and eigenvectors of, 255–257

multiplying, 251–252

solving systems of differential equations

using, 258–261

subtracting, 249

mixing fluids equation, 280

motion of mass on spring equation, 282

motion of pendulum equation, 7, 281

$\mu(x)$. *See also* integrating factors

identifying, for linear first order equations, 15–16

integrating factors as functions of, 15, 277

multiplying matrices, 251–252

• **N** •

Newton's law of cooling, 281

nonhomogeneous linear higher order differential equations

answers to problems, 162–174

general form, 153

method of undetermined coefficients

overview, 153–154

when $g(x)$ involves sines and cosines, 153, 159–161

when $g(x)$ is in the form of e^{rx} , 153, 154–156

when $g(x)$ is a polynomial of order n , 153, 157–159

nonhomogeneous linear second order differential equations

answers to problems, 115–127

defined, 82

method of undetermined coefficients overview, 105–106

when $g(x)$ involves sines and cosines, 105, 112–114

when $g(x)$ is in the form of e^{rx} , 105, 106–109

when $g(x)$ is a polynomial of order n , 105, 109–112

nonlinear differential equations

for angle of pendulum, 7

defined, 7

linear equations versus, 7

second order, 82

separable first order, 30

n th order differential equations. *See* higher order differential equations

• **O** •

ordinary differential equations

answers to problems, 190–197

defined, 177

series solutions for, 184–186

orthogonal trajectories, 280

• **P** •

pendulum motion equation, 7, 281

pipe, fluid flow in, 279–280

polynomials

coefficients in equations with regular singular points, 203

$g(x)$ as polynomial of order n

for nonhomogeneous linear higher order equations, 153, 157–159

for nonhomogeneous linear second order equations, 105, 109–112

population growth equation, 279

power series

defined, 177

finite versus infinite, 177

for ordinary differential equations

answers to problems, 188–197

ratio test for convergence, 178–180

shifting the series index, 181–183

solving, 184–186

substitutions for y , y' , and y'' terms, 184

overview, 277

for unbounded differential equations

answers to problems, 215–223

classifying singular points as regular or irregular, 203–205

Euler's equation for, 206–214
 finding singular points, 199–202
 with regular singular points, 211–214
 Web resource for, 277

powers
 linear and nonlinear equations
 distinguished by, 7
 of r , in characteristic equation, 129
 raising both sides of equation to power of e , 13, 16

• R •

radioactive decay equation, 281

ratio test for power series convergence
 answers to problems, 188–189
 overview, 178–180

real and distinct roots
 of characteristic equation
 for homogeneous linear higher order equations, 130–133
 for homogeneous linear second order equations, 86–89
 of Euler's equation, 206

real, identical roots
 of characteristic equation
 for homogeneous linear higher order equations, 135–138
 for homogeneous linear second order equations, 91–93
 of Euler's equation, 206

real-world applications, 279–282

regular singular points
 answers to problems, 217–219, 222–223
 defined, 203
 identifying, 203–205
 polynomial coefficients in equations
 with, 203
 solving general differential equations
 with, 211–214

resistance, electrical, 281–282

roots of characteristic equation
 for homogeneous linear higher order equations
 answers to problems, 139–151
 complex, 133–135
 real and distinct, 130–133

real, identical, 135–138
 Web-based equation solver for, 129

for homogeneous linear second order equations
 answers to problems, 94–104
 complex, 89–91
 real and distinct, 86–89
 real, identical, 91–93
 types possible, 87, 130
 Web-based equation solver for, 129

roots of Euler's equation, cases for, 206

Runge-Kutta method, 278

Ryan, Mark (*Calculus For Dummies*), 2

• S •

second order differential equations
 answers to problems, 94–104
 assuming solutions in the form $y = e^{rx}$, 86

characteristic equation
 with complex roots, 89–91
 defined, 86
 with real and distinct roots, 86–89
 with real, identical roots, 91–93
 types of solutions possible for, 87
 guessing a solution, 84–86

linear
 converting between forms, 82
 general form, with coefficient of y'' , 82
 general form, without coefficient of y'' , 81
 initial conditions with, 81
 where $p(x)$, $q(x)$, and $g(x)$ are continuous functions, 81–93

linear homogeneous
 answers to problems, 94–104
 with complex roots, 89–91
 constant coefficients for, 84–93
 defined, 82
 with real and distinct roots, 86–89
 with real, identical roots, 91–93

linear nonhomogeneous
 answers to problems, 115–127
 defined, 82
 method of undetermined coefficients, 105–114
 when $g(x)$ involves sines and cosines, 105, 112–114

second order differential equations

(continued)

when $g(x)$ is in the form of e^{rx} , 105, 106–109

when $g(x)$ is a polynomial of order n , 105, 109–112

nonlinear, 82

separable first order differential equations

answers to problems, 43–57

converting to, using $y = vx$ substitution trick, 35–38

defined, 29, 275

examples, 29–31

general form, 30

implicit solutions to, 33–35

initial conditions with, 41–42

nonlinear, 30

practicing separation skills, 39–40

Web resource for, 276

series solutions

for ordinary differential equations

answers to problems, 188–197

finite versus infinite power series, 177

power series, defined, 177

ratio test for power series convergence, 178–180

shifting the series index, 181–183

solving using power series, 184–186

substitutions for y , y' , and y'' terms, 184

overview, 277

for unbounded differential equations

answers to problems, 215–223

classifying singular points as regular or irregular, 203–205

Euler's equation for, 206–214

finding singular points, 199–202

with regular singular points, 211–214

Web resource for, 277

shifting the power series index

answers to problems, 189–190

overview, 181–183

sines

$g(x)$ involving

in nonhomogeneous linear higher order equations, 153, 159–161

in nonhomogeneous linear second order equations, 105, 112–114

Laplace transforms of functions, 227

singular points

answers to problems, 215–223

defined, 177, 199

finding, 199–202

irregular, equations unsolvable near, 199

regular versus irregular, 203–205

regular, solving general differential equations with, 211–214

unbounded differential equations resulting from, 199–200

spring, motion of mass on, 282

substitution

of power series for y , y' , and y'' terms, 184

$y = e^{rx}$ for $y = f(x)$, 85

$y = vx$, for solving separable first order equations, 35–38

$y = x'$ in Euler's equation, 206

subtracting matrices, 249

systems of linear first order differential equations

adding matrices, 249–250

answers to problems, 262–271

determinant of matrices, 253–254

eigenvalues and eigenvectors of matrices, 255–257

multiplying matrices, 251–252

solving, 258–261

subtracting matrices, 249

• T •

temperature change equation, 281

f'' functions, Laplace transform of, 226

trajectories equation, 280

trigonometry

$g(x)$ involving sines and cosines

for nonhomogeneous linear higher order equations, 153, 159–161

for nonhomogeneous linear second order equations, 105, 112–114

for solving homogeneous linear second order equations with complex roots, 90

• U •

unbounded differential equations

answers to problems, 215–223

classifying singular points as regular or irregular, 203–205

defined, 199
 Euler's equation for solving, 206–214
 finding singular points in, 199–202
 with regular singular points, solving,
 211–214
 undetermined coefficients, method of. *See*
also constant coefficients
 for nonhomogeneous linear higher order
 equations
 answers to problems, 162–174
 overview, 153
 when $g(x)$ involves sines and cosines,
 153, 159–161
 when $g(x)$ is in the form of e^{rx} , 153,
 154–156
 when $g(x)$ is a polynomial of order n , 153,
 157–159
 for nonhomogeneous linear second order
 equations
 answers to problems, 115–127
 overview, 105
 when $g(x)$ involves sines and cosines,
 105, 112–114
 when $g(x)$ is in the form of e^{rx} , 105,
 106–109
 when $g(x)$ is a polynomial of order n , 105,
 109–112
 Web resource for, 276

• v •

velocity of falling object, 280

• w •

Web resources

acceleration and velocity of falling
 object, 280
 computer-based numerical methods, 278
 determining whether solution exists, 278

exact first order differential equations, 277
 fluid flow, 279–280
 homogeneous differential equations, 276
 inductor-resistor circuits, 281–282
 integrating factors, 277
 Laplace transforms, 278
 method of undetermined coefficients, 276
 mixing fluids, 280
 motion of mass on spring, 282
 Newton's law of cooling, 281
 orthogonal trajectories, 280
 pendulum motion, 281
 population growth equation solutions, 279
 radioactive decay, 281
 separable differential equations, 276
 series solutions or power series, 277
 solving linear first order differential
 equations, 275
 Web-based equation solvers, 129

• y •

y , y' , and y'' terms
 linear versus nonlinear equations
 distinguished by, 7, 275
 power series substitution for, 184
 $y = e^{rx}$. *See also* characteristic equation
 solution in the form of
 for homogeneous linear higher order
 equations, 129
 for homogeneous linear second order
 equations, 86, 91
 substituting for $y = f(x)$, 85
 $y = vx$ substitution trick
 answers to problems, 47–51
 for converting to separable equations,
 35–38
 general form suitable for, 35
 $y = x^r$, solution for Euler's equation in form
 of, 206, 211

