Index

acceleration, 232
accuracy, limits of, 14
addition
  algebraic fractions, 155
  column vectors, 256
  matrices, 274
  vectors, 250
algebra, 44–81, 153–81
algebraic fractions
  addition, 155
  simplification, 153–4
  subtraction, 155
alphabetical sequences, 355
AND rule, 331
angles
  bisectors, 142
  polygons, 116–18
  right-angled triangles, 187–9
  on straight lines, 115
approximations, 8–12
arc length, 91–4
Archimides of Samos (287–212 BC), 82
area, 82–7
  circles, 87–8
  and perimeter, 348–9
  similar shapes, 128–31
  surface, 105–7
arithmetic, 2–5
asymptotes, 221
averages, 315–23

bar charts, 36–7, 307–8
  see also histograms
base vectors, and matrices, 297–8
bearings, 190–3
best fit, line of, 321
bisectors, 142
BODMAS rule, 4
bounds, 9–12
boxes, maximum, 352–3
brackets, 50–2
businesses, running, 360–1

calculators, 13
  operations, 33–5
  puzzles, 356
  words on, 364–5
car hire, 360
Cardan, Girolamo (1501–76), 153
Ceulen, Ludolph van (1540–1610), 87
chess boards, 348, 363
chords, 95–7
circles, 87–91
  arc length, 91–4
  area, 87–8
  chords, 95–7
  circumference, 87–8
  sector area, 91–4
  segments, 95
  tangents to, 138–41
  theorems, 134–41
circumference, 87–8
column vectors, 255–61
  addition, 256
  parallel, 257–9
  scalar multiplication, 256
  subtraction, 256
composite functions, 267
compound interest, 26
computers, 87
  spreadsheets, 35–7
cones
  surface area, 105
  volume, 100
congruency, 127
constructions, 142–5
correlation, 320
cosine function, 183, 197–9
cosine rule, 202–5
cross numbers, 361–2
cube numbers, 5
cubes
  nets, 145
  painting, 350
cuboids, volume, 97
cumulative frequency, 324–7
curves, plotting, 217–23
cylinders
  similarity, 131
  surface area, 105
  volume, 98, 356, 358

data, displaying, 307–14
decimals, 2–3
  and fractions, 5
  and percentages, 21
Descartes, René (1596–1650), 211
determinants, 277
diagonals, 356

diagrams
  expanding, 354
  tree, 333–7
  Venn, 241–6
  see also flow diagrams; graphs
difference of two squares, 70–1
digits, sum of, 353
direct variation, 162–4
directed numbers, 44–6
discs, 347–8
distance, 28–33
  stopping, 358
distance–time graphs, 229–32
distance travelled, 232
distributive law, 50

Einstein, Albert (1879–1955), 274
elimination method, 64–5
enlargements, 286–8
equations
  graphical solution, 225–9
  see also linear equations; quadratic equations; simultaneous equations
estimations, 12–13, 362
Euler, Leonard (1707–83), 182
events, 327
  exclusive, 331–2
  independent, 331–2
exchange rates, 18–19
experiments, 361–5
exponential functions, 221

factorising, 68–71
factors, 5
Fibonacci sequence, 354–5
flow diagrams, 357
  functions, 265, 267–8
foreign exchange, 18–19
formulae, 46–50
  changing subject of, 156–61
fractions, 4
  and decimals, 5
  and percentages, 21
  see also algebraic fractions
frequency density, 311–12
frequency tables, 312–14, 315–18
frogs (game), 345–6
functions, 265–9
  composite, 267
  exponential, 221
  flow diagrams, 265, 267–8
  inverse, 267–9
  notation, 265
  quadratic, 217

Gauss, Karl Friedrich (1777–1855), 1
geometry, 114–52
  fundamental results, 115–19
  vectors, 261–4
gradients, 229
  of graphs, 213–14
  of tangents, 218–19
graphs, 211–40
  accurate, 211–13
  curved, 217–23
  distance–time, 229–32
  equation solving, 225–9
  gradients of, 213–14
  of inequalities, 172–3
  interpretation, 224–5
  scatter, 37, 319
  of sine function, 197
  sketch, 215, 221–3
  speed–time, 232–5
  of tangent function, 199
  see also diagrams; straight line graphs

happy numbers, 349
histograms, 311–14
  see also bar charts
Hui, Liu (3rd century AD), 87

identity matrices, 277
indices, rules of, 167–70
inequalities, 170–3
  graphs of, 172–3
  reversed, 170
integers, 5
interest
  compound, 26
  simple, 26
interquartile range, 324
inverse functions, 267–9
inverse matrices, 277–8
inverse variation, 164–7
investigations, 343–58
irrational numbers, 6–7, 87

kites
  area, 82
  symmetry, 122
knockout competitions, 347

line symmetry, 122
linear equations, 52–7
  problem solving, 57–62
linear laws, 216–17
linear programming, 174–7
linear scale factor, 128
lines
  of best fit, 321
  number, 171–2
  parallel, 118–19
  see also straight lines
loci, 142–5
logical problems, 247–9
lower quartile, 324

map scales, 19–21
matrices, 274–8
  addition, 274
  and base vectors, 297–8
  determinants, 277
  identity, 277
  inverse, 277–8
  multiplication, 275–6
  operations, 274–6
  square, 275
  subtraction, 274
  and transformations, 292–9
mean, 315–23
measurements, bounds, 9–12
median, 315–23, 324
mensuration, 82–113
mirror lines, 279
mode, 315–23
modulus, of vectors, 260–1
multiples, 5
multiplication
  matrices, 275–6
  vectors, 250–5, 256
mystic rose, 346

nets, 145–6
Newton, Isaac (1642–1727), 44
number lines, 171–2
number squares, 344
numbers, 1–43
  biggest, 356
  creating, 363
  cross, 361–2
  cube, 5
  directed, 44–6
  facts, 5–7
  happy, 349
  irrational, 6–7, 87
  prime, 5, 349–50
  rational, 6–7
  square, 5
  standard forms, 13–15

opposite corners, 344
OR rule, 331

paper, cutting, 351
parallel lines, 118–19
parallel vectors, 257–9
parallelograms
  area, 84
  symmetry, 122
Pascal, Blaise (1623–62), 307
patterns, tiles, 355
pentominoes, 364
percentages, 21–7
  and decimals, 21
  decrease, 24
  and fractions, 21
  increase, 24
perimeter, and area, 348–9
pi (π), 87
pie charts, 36–7, 308–11
Pisa, Leonardo de (1170–1250), 354
points, loci of, 143–5
polygons, angles, 116–18
position vectors, 261
powers, rules of, 167–70
prime numbers, 5, 349–50
prisms, volume, 97
probability, 327–37
  simple, 327–31
problem solving
  linear equations, 57–62
  quadratic equations, 74–7
  simultaneous equations, 65–7
problems
  logical, 247–9
  practical, 359–61
  three-dimensional, 194–6
proportion, 16–21
proportionality, 162–7
puzzles, 361–5
pyramids, volume, 100
Pythagoras (569–500 BC), 114
Pythagoras' theorem, 75, 105, 119–21, 260

quadratic equations, 71–4
  graphical solution of, 225–6
  problem solving, 74–7
  solution by factors, 71–2
  solution by formula, 73–4
quadratic functions, 217
quadrilaterals, symmetry, 122
quartiles, 324

rational numbers, 6–7
ratios, 15–21
rectangles
  area, 82
  diagonals, 356
  similarity, 128
  symmetry, 122
reflections, 279–81
rhombuses, symmetry, 122
right-angled triangles
  angles, 187–9
  Pythagoras' theorem, 119–21
  side length, 183–7
  trigonometry, 182–93
rotational symmetry, 122
rotations, 282–4
Russell, Bertrand (1872–1970), 241

scalars, vector multiplication, 250–5, 256
scale drawings, 193–4
scales, maps, 19–21
scatter graphs, 37, 319
scores, final, 351
sector area, 91–4
segments, 95
sequences, 7–8
  alphabetical, 355
  Fibonacci, 354–5
  shapes, 352
sets, 241–6
  intersection, 241
  notation, 241–2
  union, 241
  universal, 242
shapes
  sequences, 352
  similar, 128–31
shears, 298
Shockley, William (1910–89), 343
sigma (S), 315
similarity, 124–34
simple interest, 26
simplification, 50–2
  algebraic fractions, 153–4
simultaneous equations, 62–5
  elimination method, 64–5
  problem solving, 65–7
  substitution method, 62–3
sine function, 183, 197–9
sine rule, 199–201
sketch graphs, 215, 221–3
speed, 28–33, 229
  and stopping distances, 358
speed–time graphs, 232–5
spheres
  similarity, 132
  surface area, 105
  volume, 100
spreadsheets, 35–7
square matrices, 275
square numbers, 5
squares, 350
  symmetry, 122
stamps, buying, 345
standard forms, 13–15
statistics, 307–27
stopping distances, 358
straight line graphs, 211–17
  gradients, 213–14
  intercepts, 215
straight lines
  angles on, 115
  equation of, 215–16
stretches, 298–9
substitution method, 62–3
subtraction
  algebraic fractions, 155
  column vectors, 256
  matrices, 274
surface area, 105–7
symmetry, 122–4

tangent function, 183, 197–9
tangents
  gradients of, 218–19
  to circles, 138–41
three-dimensional problems, 194–6
tiles, patterns, 355
time, 28–33
timetabling, 359–60
transformations, 279–99
  combined, 289–92
  inverse, 290–2

and matrices, 292–9
repeated, 290
simple, 279–88
translations, 284–5
trapeziums
area, 82
symmetry, 122
tree diagrams, 333–7
trials, 327
triangles
area, 84
similarity, 124
see also right-angled triangles
trigonometry, 182–210
triples, 346

upper quartile, 324

variation, 162–7
vectors, 250–64
addition, 250
base, 297–8
geometry, 261–4
modulus, 260–1
parallel, 257–9
position, 261
scalar multiplication, 250–5
see also column vectors
Venn diagrams, 241–6
volume, 97–104
maximum, 352, 356, 358
similar objects, 131–4

weighing scales, 345
words, on calculators, 364–5