

A

- absolute entropy, 566–570
- absorption, 176, 183, 188
- acetaldehyde, 475, 477, 480
- acetamide, 478
- N*-ethyl-*N*-phenyl acetamide, 481
- acetate anion, 337–338, 339
- acetic acid, 455, 477, 478, 480, 743, 751, 888
 - ATP-forming reactions, 595
 - beyond stoichiometric point, 790
 - buffer solution, 771–773, 774, 782
 - Lewis structure, 269–270, 322
 - production, 655
 - weak acid, 709
- acetic anhydride, 42, 47–48
- acetone, 368, 369, 372, 374, 416, 418, 431, 475, 480, 590
- acetonitrile, 418, 479, 480
- acetophenone, 994
- acetyl chloride, 994, 996
- acetylene, 3, 73, 77, 319, 325–326, 454
- acetyl phosphate, 595
- achiral molecules, 491
- acidosis, 771
- acid rain, 60, 101, 808, 1008
- acid rock drainage, 968–969
- acids. *See also* specific acids
 - amino acids properties, 745
 - Brønsted–Lowry theory, 726
 - carboxylic acid (*See* carboxylic acid)
 - catalyzed hydration, 537
 - charge, effect of, 752
 - conjugate pairs, 727–728
 - diprotic, 756, 794–798
 - factors affecting strength, 752–753
 - hydrolysis constant, 709, 736
 - identifying, 744
 - industrial importance of, 707
 - Lewis (*See* Lewis acids)
 - oxoacid, 262, 742, 751, 753
 - polyprotic, 744, 752, 755–759
 - recognizing, 741–758, 751
 - salts, 748–750, 808–809
 - soil acidity, 817–818
 - solutions, 29
 - strong, 425, 707, 729–730, 751
 - structural factors, 752–753
 - summary of, 751
 - weak, 709, 735–738, 743, 748–750, 751, 787–790
- acids and bases. *See also* acids; bases
 - factors affecting acid strength, 752–753
 - multiple equilibria, 754–762

pH scale, 732–735
proton transfer in water, 726–732
recognizing, 741–758
salts, 748–751
titrations (*See* titration)
weak, 735–741
acrylonitrile, 35, 266, 479, 572–573, 575–576,
615, 892, 893
acryloyl chloride, 341
actinides, 937
actinium, 937
activation energy, 644–645, 646–648, 649,
1026–1027
activity in solutions, 678–679
addition reaction, 506, 532–539
acid-catalyzed hydration, 537
alkenes, 533, 534–535
catalyst, function of, 534
described, 532
double bond, characteristics of, 534–535
electrophilic addition of bromine and chlorine
to alkenes, 537–538
halogens, to double bond, 538
hydrogenation, 533–534
identification of, 507
Markovnikov's rule, 535–537
water to alkenes, 537
adducts, 983–984, 994
adenine, 912, 915, 917
adenosine, 912, 913, 1002
diphosphate (ADP), 593, 595, 596, 1002
monophosphate (AMP), 913
triphosphate (ATP), 23, 593–596, 657, 918,
1002
adhesive forces, 374
adipic acid, 751, 897
adjacent isomer, 943
ADP. *See* adenosine
adsorption, 654
aerosols, 441
agriculture, 41–4, 244, 443, 672, 817–818, 989
alanine, 919, 920, 925
alcohols, 468–471, 480, 514, 753, 888
aldehydes, 474–476, 480, 888
alkali fuel cells, 870
alkali metals, 243, 420
alkaline dry cell, 865–868
alkaline earth metals, 243
alkaloids, 746
alkalosis, 771
alkanes, 274, 366, 453, 454–455, 455, 457–461,
460–461, 461
alkanol, 469
alkenes, 323–324, 453, 531

- additions to, 533, 534–535
- Diels–Alder reaction, 625
- electrophilic addition of bromine and chlorine, 537–538
- hydrogenation of, 533
- naming, 462
- polymers from, 892
- triethylaluminum, 282
- unsymmetrical, 535
- water, addition of, 537
- alkyl groups, 456–457, 466
- alkyl halides, 466–468, 513, 519, 525, 527, 528
- alkyllithium reagents, 989
- alkynes, 454, 462
- allotropes, 1004
- alloy formation, 998
- alloys, 420–421
- alpha emission, 1030
- alpha-galactose, 907–923
- alpha-glucose, 909–910, 911
- alpha-idose, 907
- alpha-tocopherol, 419
- alum, 968
- alumina, 378
- aluminosilicates, 280
- aluminum, 215, 218, 223, 224, 234, 242, 345, 568, 849, 989, 990–994
- aluminum bromide, 994
- aluminum chloride, 993–994
- aluminum halides, 989
- aluminum hydroxide, 244, 994, 1007
- aluminum iodide, 994
- aluminum nitrate nonahydrate, 240
- aluminum oxide, 378, 990, 1007
- aluminum refinery, 829
- aluminum sulphate, 994, 1007
- aluminum trihalides, 994
- amalgam, 421
- Amazon rubber industry, 895
- amide linkages, 890, 896
- amides, 478, 479, 480, 890
- amines, 472–474, 480, 744, 751, 888
- amino, 461
- amino acids, 280, 371, 452, 745, 890, 896, 918, 918–935. *See also* specific amino acids
- aminobenzene, 464
- amiprophos, 1003
- ammine, 924
- ammonia, 81, 289, 371, 584, 586–587, 708
 - aqueous, 89, 415–416
 - chemical recipe for, 35
 - chlorine bleach and, 840–841
 - conjugate acid of, 727–728, 750
 - diffusion example using, 89

- in fertilizers, 41–42
- gaseous, 41, 982
- Haber process synthesis, 31, 40, 126–127, 672, 676, 681, 687, 688–689
- Lewis base, 982, 983
- limiting reactant situation, 44
- molecular representation, 3, 31
 - as nucleophile, 524
 - organic derivatives of, 472
 - pH, 738–739
 - phase diagram, 399
 - proton transfer, 710
 - reactivity trend for adduct formation, 989
 - solubility, 428
 - stoichiometric ratio and, 44
 - synthesis, 615, 650
 - tetrahedral electron group geometry, 276
 - titration, 800
 - weak base, 744, 751
- ammonium, 442, 710
- ammonium cation, 750
- ammonium chloride, 89
- ammonium dichromate, 971
- ammonium hydrogen phosphate, 1002
- ammonium hydroxide, 89, 415–416
- ammonium nitrate, 21–22, 26, 33, 41–42, 77, 136, 143, 425, 586, 831
- ammonium sulphate, 27, 41
- amorphous solids, 383, 391–392
- AMP. *See* adenosine
- amphetamine, 472
- amphiprotic, 728
- amplitude of light, 168, 169, 170
- amylose, 910
- amyotrophic lateral sclerosis (ALS), 960
- anabolic steroid, 494
- anhydrous calcium sulphate, 582
- aniline, 745, 751
- animals
 - bioenergetics, 592–596
 - carbohydrates, 592–594
 - DDT effect on, 1013
 - dioxins, 1013
 - enzymes, 655–658, 809
 - glucose, storage of, 910
 - nitrogen oxide, synthesis of, 982
 - pheromones, 323–324
 - phosphate effect on, 1002
 - phosphorus in, 999
 - polysaccharides, 905
 - transition metals, 936
- anions
 - cation ratio, 26
 - defined, 226

- formal charge, 267–270
- in industrial processes, 244
- Lewis structure of, 263–264
- oxoanions, 244, 271–272, 344
- periodic table placement, 241
- stability, 240
- stability of, 233, 234
- answers to exercises. *see* exercises, end of chapters
- Antarctica, 198, 606, 653
- anthropogenic aerosols, 441
- antibonding molecular orbital, 328, 331–332
- antimony, 220, 242, 996, 998
- apatite, 999, 1001
- apatites and phosphorus, 999
- aqueous equilibria, 673–674, 706–715
 - acid–base titrations, 784–801
 - buffer solutions (*See* buffer solutions)
 - complexation equilibria, 811–818
 - identifying types of, 711–712
 - solubility equilibria, 801–803
 - species in solution, 706–709
 - spectator ions, 712–714
 - types, 709–711
- aqueous solutions, 23–31. *See also* solutions
- aqueous equilibria (*See* aqueous equilibria)
- boiling points, 433–435
- buffer solutions (*See* buffer solutions)
- characteristics, 423–429
- colligative properties, 429–439
- concentration (*c*), 23–24
- constant-pressure calorimetry, 135–136
- defined, 23
- dilution, 28–29
- distillation, 432–433
- energetics of salt solubility, 424–425
- equilibrium, 426–428
- freezing points, 433–436
- ionic solutions, concentrations of, 26–28
- molarity, 23–24, 27, 413–414, 424–425
- molecular view, 26
- osmosis, 436–439
- preparation of, 24–25, 30
- proton transfer, 709–710
- reactions, 673
- recrystallization, 425–426
- solubility equilibrium, 423–424, 710–711
- species, 25–26, 706, 706–709, 708–709, 711
- spectator ions, 712–714
- temperature, effect of, 425–426
- vapour pressure reduction, 429–432
- water (*See* water)
- area, force per, 60
- argentite, 988

arginine, 919
argon, 81, 95, 114, 182, 215, 218, 364, 368, 396,
568
aromatic compounds, 463–466
aromatic substitution reactions, 526
Arrhenius, Svante, 740–741
Arrhenius equation, 645–648, 648
arrow pushing, 512
arsenic, 221, 242, 350, 996, 998–999
artificial orange flavouring, 478
artificial rubbers, 904
ascorbic acid, 419
asparagine, 23, 919
aspartic acid, 745, 919
aspirin, 42, 47–48
atmosphere. *See* Earth's atmosphere
atmospheric gases. *See* Earth's atmosphere;
specific gases
atomic
 combining, 19
 configurations representation, 221–224
 corral, 5, 6
 energy, 174–176
 force microscopy (AFM), 5–6
 ground states, 216–219
 microscopy, 5–6
 numbers (Z), 193, 194, 215
 orbitals (*See* orbitals)
 radii, 230–231
 size, 230–231
 spectra, 176–177
 theory, 308
 view, 3
 volume, 167–168
atomic hydrogen. *See* hydrogen
atoms, 2, 165–207
 absorption, 174–176, 178
 in atmosphere, 196–198
 atomic-level microscopy, 5
 attraction, 167
 aufbau principle, 216
 axis, 189, 190, 194
 bonds, 168, 172, 255, 265
 characteristics, 2, 166, 166–168, 228
 charges, 113, 178
 colour-coded scale models, 3
 composition, 113
 conservation law, 32
 contour drawings, 195
 counting, 13–15
 diamagnetic, 227
 donor atoms, 941
 electron affinity (*EA*), 233–234
 electron cloud, 167

electron configurations, 221, 227
electronegative, 263
electrons, 166, 194
electrons distribution shorthand notation, 221
energy, 174–176, 175, 178–179, 179–182,
188, 189
equation balancing, 32
formal charge (FC), 267–270
ground-state configuration, 216, 228
inner, 261, 263, 265–267, 278, 312, 314,
315–316
ionic compounds, 236–241
isoelectronic, 226
lasers and, 166
ligands, 275, 276
and light, 174–177
magnetic properties, 227–228
mass, 12–13, 14–15, 166
multielectron, 211–212, 232
neutral, 215, 218, 228, 233, 235
nodes, 193, 194
nuclear charge (Zeff), 212–214
nuclei, 166, 193, 211, 229
orbitals, 188, 189, 194, 229, 234
outer, 261, 263, 265
paramagnetic, 227
protons in nucleus, 193
quantum numbers (n), 188–192, 194, 212–214
radius, 386
representation, 3
Schrödinger equation, 188
screening, 230
size, 192, 230, 230–231
stability, 234
states, 174, 217, 228
steric number (SN), 275, 276
volume, 167–168
ATP. *See* adenosine
atropine, 746, 747
attraction, 167, 175, 255–256, 258. *See also*
intermolecular forces
aufbau principle, 216–218, 224, 233, 309, 328,
331, 346
autohydrolysis of water, 728–729
Avogadro's number, 13, 14, 15, 63, 80, 167,
181–182, 857, 1024
axial positions, 284
azeotropes, 433
azide ion, 339
azulene, 345

B

ball-and-stick model, 261, 998

Ballard fuel cell, 869
Balmer's equation, 178
band gap, 347, 350
band theory of solids, 345–350
bar, unit of pressure, 8, 61
barbiturates, 746
barium, 381, 937
barium hydroxide, 707, 751
barium nitrate, 22
barium sulphate, 706
barometers, 60–61
Barrick Gold Corporation, 968
Bartlett, Neil, 286–287
base hydrolysis constant, 710
bases
 amino acids, basic properties of, 745
 Brønsted–Lowry theory, 726
 conjugate acid–base pairs, 727–728
 conjugate base, 727
 hard and soft, 994
 identifying, 744–746
 of industrial importance, 707
 Lewis bases (See Lewis bases)
 pairs, 727–728, 771, 915
 recognizing, 741–758, 751
 salts of weak bases, 750–751
 strong, 707, 730–732, 751
 summary of, 751
 water as, 709
 weak, 710, 738–740, 744–746, 750–751, 751,
 790–794
batteries, 845, 846, 850, 865–868, 998. *See also*
 electrochemical cell; galvanic cells;
 specific types of batteries
bauxite, 990
bent molecules, triatomics, 339
bent shape, 277
benzaldehyde, 475
benzalkonium chloride, 444
benzene, 344, 374, 396, 431, 432–433, 463,
 464–466, 1009
benzene–toluene mixture, 430–431, 432–433
benzoate anion, 700–711, 702–703, 743
benzoic acid, 377, 430, 477, 697–698, 700–711,
 704, 751
benzophenone, 200
benzyl alcohol, 469
beryl, 279, 381
beryllium, 243, 244
beta-carotene, 324, 343, 344, 453, 454
beta emission, 1030
beta-galactose, 911
beta-glucose, 911
beta-gulose, 911

beta particles, 1030
bidentate, 813
bidentate ligands, 941
bimolecular reactions, 516, 607, 613, 635, 643
binary compounds, 240
binary gases, 81, 372–373
biocatalysis, 655–658
biochemical energy production, 592–596
biochemical reactions, 243
biochemistry, 1012
bioenergetics, 592–596, 592–596, 594–596, 595,
595–596
bioethanol, 539
biological calorimeters and sizes of organisms,
138
biological molecules, 280–284
biology, and transitional metals, 957–961
biomagnification and animals, 293
bipyridine ligand, 941
bismuth, 242
Blixen, Karen, 817
blood, 23, 437–438, 771, 982
blue copper proteins, 960
Blue Grotto, 714
body-centred cubic structure, 384–385
Bohr's equation, 178
boiling points, 363–364, 367, 369, 372–373,
433–435, 435
Boltzmann constant, 559
Boltzmann equation, 559–560, 565
bomb calorimeter, 138
bond angles, 289–290
bond dissociation and ionization, 236
bond energy (BE), 114, 128–130, 131, 150–151,
295–297, 333
bonding, 253–302
 in atmosphere, 196
 ball-and-stick model, 261, 273
 bond energy (BE), 128, 295–297
 bond length, 293–295
 boron, 996
 coordination complexes, 948–957
 covalent bonds (See covalent bonds)
 delocalized, 307, 996
 described, 128, 254–259
 double, 320–321, 321–322, 340–341, 343,
 534–535, 538
 electronegativity, 258–259
 electron interactions, 274
 endothermic, 126
 energy (BE), 123–124, 128, 254–255,
 255–257
 exothermic, 126
 hydrogen molecule, 255

- inorganic compounds, 261
- ionic compounds, 259
- length, 255–257, 293–295
- Lewis structures, 260–272, 264–272
- ligand, 275
- in liquids and solids, 128
- localized bonds, 307
- multiple bonds, 319–326
- nuclear-nuclear interactions, 274
- nucleus charge, 258
- octets, 263, 267
- orbitals, 257, 307–309, 328
- order, 328
- phosphorus (V) oxide, 1001
- pi (π) bond, 321
- picture procedure, 321
- polarity, importance of, 291–293
- reactions, 125–126
- sigma (σ) bond, 320
- in solids and liquids, 128
- structures and conventions, 130, 261–262, 262–264
- theories of (See bonding theories)
- triple, 325–326
- types, 126, 128–129, 129–130, 255, 257, 258–259, 261, 265, 269, 294

bonding theories

- band theory of solids, 345–350
- composite model of bonding, 336–338
- delocalized ? orbitals, 335–339
- diatomic molecules, 327–329
- extended ? systems, 339–344
- hybridization of atomic orbitals, 311–315
- localized bonds, 307
- metallic bonding, 345–350
- molecular orbital theory, 327–329
- multiple bonds, 319–326
- orbital overlap, 307–309, 310
- three-centre ? orbitals, 335–339

borax, 996

boric acid, 996, 999

Born-Haber cycle, 238–239. *See also* Haber process; Haber reaction

boron, 244, 988, 989, 996, 996–997, 997

Bose, S.N., 569

Boyle, Robert, 62, 66

the brain, and drugs, 746–747

branched-chain alkanes, 457–461

Brand, Hennig, 999, 1000

brass, 416, 420

Broglie, Louis de, 184

tert-butyl bromide, 467

bromide anion, 240

bromide ion, 523

bromine, 3, 145, 362, 364, 396, 526, 535,
537–538, 568, 588, 630–631, 649, 1012
bromoacetic acid, 477
bromobenzene, 465
2-fluoro-3-bromobutane, 484
bromocresol, 799
bromoethanoic acid, 477
bromo ligand, 461, 941
(*R*)-2-bromooctane, 517
3-bromopentane, 530
1-bromopropane, 535
2-bromopropane, 466, 532, 535
Brønsted, Johannes, 726
Brønsted–Lowry acid–base, 982, 1006
Brønsted–Lowry theory, 726
bronze, 971, 972, 995
buckminsterfullerene, 382, 1004, 1005
buffering, 771–779
buffer solutions, 771–779, 781, 781–784
butadiene, 339–340, 625–626, 893, 896, 1009
butane, 275, 369, 455, 458, 488
butanenitrile, 479, 481
2-ethyl butanoic acid, 479
(*R*)-2-butanol, 517
2-butanol, 470, 538
2-methyl-2-butanol, 470–471
butanone, 475
butene, 462
1-butene, 462
1-chloro-2-butene, 462
2-butene, 462
2-methyl-1-butene, 462
3-phenyl-1-butene, 538
cis-2-butene, 611, 620, 621, 643, 649
trans-2-butene, 611, 649
butyl, 456
tert-butyl, 456
1-butyl-2,4-difluorobenzene, 464
tert-butyl alcohol, 469
tert-butylcyclohexane, 462

C

cadmium, 381, 803, 845, 995
cadmium hydroxide, 868
caffeine, 2
Cahn, Robert Sydney, 482
calaverite, 988
calciferol, 419
calcium, 215, 243–244
calcium carbide, 73, 84
calcium carbonate, 240, 578, 690, 714–715, 801,
806–809, 808, 818
calcium chloride, 244, 423–424, 692–693

- calcium disodium, 814
- calcium fluoride, 1007
- calcium hydroxide, 707, 751
- calcium hypochlorite, 22
- calcium oxide, 391–392, 578, 690, 966
- calcium silicate, 278, 966
- calcium sulphate, 582, 801–802, 1007
- calcium sulphate dihydrate, 582
- calcium sulphite, 101
- calorimeters, 134–136, 137, 138, 142
- calorimetry, 133–140, 144
- Cameco Corporation, 968
- Canadian metal mining industry, 968–969
- Canadian Shield, 968
- Canadian Society for Chemistry, 287
- CANDU reactors, 90
- capillary action, 373
- capillin, 454
- carbocation, 509, 521, 531
- carbohydrates, 592–594, 905–911
- carbon, 2, 242, 1004–1006
 - bonding energies, 129–130
 - chain in molecular shape, 275
 - chemical bonds in molecules, 17
 - classifications of atoms, 467
 - color-coded scale model, 3
 - cycle, 809–810
 - diameter of carbon atom, 7
 - in graphite, 13
 - as greenhouse gas, 810
 - insulator, 347
 - nanobuds, 1006
 - nano-onions, 1006
 - nanotubes, 1005–1006
 - pharmaceutical uses, 1006
 - pi (π) bond, 324
 - pure isotope -12, 13
 - quaternary carbon, 481
 - reaction bond energies, 131–132
 - secondary, 456
 - standard molar entropies, 568
 - structures guidelines, 16
 - tertiary carbon, 456, 469
 - tetrahedron structure, 274–275
 - types of bonds, 128–129
 - unique characteristics, 452–453
- carbon-14, 623
- carbonated water, 756–757
- carbonates, 244, 341–342, 939, 962, 986
- carbonato ligand, 941
- carbon–carbon double bond, 888
- carbon dioxide, 2, 67, 81
 - carbon cycle, 809–810
 - critical point, 399, 401

- delocalized π orbitals, 338–339
- dissolution in water, 680
- in Earth's atmosphere, 99, 197–200
- fossil fuels and release of, 153
- gaseous CO₂, 539
- global warming, 99
- human production of, 771
- linear geometry, 282
- methane combustion, 123–124
- molecular representation, 3, 4
- “scrubbers,” 870
- scuba diving, and pressure changes, 428
- carbon dioxide fire extinguishers, 85
- carbonic acid, 680, 751, 755, 756–757
- carbon monoxide, 2, 4, 81, 236, 334–335, 636–637, 959, 1009
- carbon nanotubes, 382
- carbon steel, 421
- carbon tetrachloride, 48
- carbon trioxide, 342
- carbonyl group, 474, 889
- carbonyl ligand, 941
- carborundum, 378
- carboxylate sulphonate, 442
- carboxyl group, 477, 753, 889
- carboxylic acid, 371, 476–479, 479, 480, 726, 742–743, 751, 753, 754, 888
- carnotite, 962
- Carothers, Wallace, 897
- Carson, Rachel, 1013
- carvone, 494
- (*R*)-carvone, 494
- (*S*)-carvone, 494
- casein, 1004
- Cashion, Ken, 656
- cassiterite, 994
- catalysis, 533, 651–659, 653–654, 657, 973
- catalysts, 534, 539, 651, 692. *See also* catalysis
- catalytic converters and pollution, 100
- catalytic hydrocarbon-forming reactions, 654
- cathode, 845
- cations
 - defined, 178, 226
 - earth's oceans, 243
 - electron, 226, 234–235
 - isoelectronic, 235
 - periodic table placement, 241
 - size of, 234–235
 - stability, 239–240
 - transition metals, 226
- CdS, 349
- cell membranes, 443–444
- cell potentials, 850–859, 859–862
- cellulose, 905, 910–911, 911

Celsius ($^{\circ}\text{C}$) scale conversions, 8
centimetre cubed (cm^3), 8
ceramic oxide superconductors, 382
ceramic superconductor materials, 381
cesium, 380, 390
CFCs (chlorofluorocarbons), 539, 606, 611, 651,
1011
cGMP-specific phosphodiesterase type 5 (PDE5),
982
chain theory, 947
chalcocite, 967, 1007
chalcopyrite, 967, 988
change on system at equilibrium, 689–693
charcoal, 658, 995
Chargaff, Edwin, 915
Charles, Jacques-Alexandre-César, 61
chelate effect, 813–814
chelating ligands, 813, 958
chemical bonding. *see* bonding
chemical equations, 31–34
chemical equilibrium. *See* equilibrium
chemical formulas, 3–4, 18
chemical problem solving, 10–12
chemical processes, 558, 561, 562. *See also*
spontaneity
chemical properties, 4
chemical reactions
analysis of, 43
aqueous solutions, 673
balancing, 32–34
bimolecular, 607, 613, 635, 643
bond energies, 150
conservation law, 31, 32
decomposition reaction, 126, 675
described, 4, 125
direction of, 681–682, 684
electron movement, 511–512
electron-transfer reactions (*See* electron
transfer reactions)
elementary, 607–608, 613, 638
energies, 125–133
energy changes, 115–116, 125–133, 575
enthalpy changes, 147–148
and equilibrium, 694
formation reactions, 150
free energy, 575–576
gas phase, 673
lower yield reasons, 38–39
mechanism, 606–610, 675
metathesis reactions, 989–990
multistep, 41
nuclear reactions (*See* nuclear reactions)
order of, 617
organic (*See* organic reactions)

- precipitation, 804–805
- rates of (*See* reaction rates)
- release or absorption of energy, 114
- reversibility, 638, 675–677
- speed of, 610
- stages of, 148
- standard reaction entropies, 572
- stoichiometry of, 35–37
- thermolecular, 608
- unimolecular, 607, 635, 643
- yields of, 38–42
- chemical synthesis, 35
- chirality, 452, 490, 491, 493–494
- chitin, 905, 911
- chlor-alkali process, 1009
- chlorate, 244
- chloride, 240, 531, 986
- tert*-butyl chloride, 521, 522, 531
- chlorine, 81, 531, 1008–1010
 - alkenes, addition to, 537–538
 - carbon bonds with, 1012–2013
 - color-coded scale model, 3
 - compound degradation, 1013
 - electron accessibility, 219
 - formation of sodium chloride, 236–238
 - Friedel–Crafts reaction, 994
 - gas, 362
 - hydrocarbons and, 1010
 - industrial uses and processes, 1009, 1010, 1012–1013
 - inorganic compounds, 1010
 - melting and boiling points, 364
 - molecular representation, 3
 - orbital ionization energies, 215
 - organic compounds, 1010
 - and ozone, reactions between, 606, 651–653
 - valence electrons, 267
 - xenon, reaction with, 287
- chlorine bleach, 840–841
- chlorine pentafluoride, 292
- chlorine trifluoride, 261, 267, 284, 833
- 3-chloro-1-propanol, 470
- chloroalkanes, 528
- 3-chloroaminocyclopentane, 462
- chlorobenzene, 464, 1009
- (*S*)-2-chlorobutane, 517
- 3-chlorobutanoic acid, 477
- chloroethane, 466, 480
- chloroethene, 1009
- chlorofluorocarbons (CFCs), 539, 606, 611, 651, 1011
- chloroform, 292, 1011
- chloro ligand, 461, 941, 952
- chloromethane, 518, 1009

2-bromo-4-chloropentane, 467
chlorophyll, 307, 319, 343–344, 936
chloroprene, 1009
3-chloropropan-1-ol, 470
chloropropane, 509
1-bromo-1-chloropropene, 482
chlorosilane, 998
chlorous acid, 742
cholesteryl benzoate, 393
chromate, 837–838
chromite, 970
chromium, 225, 380, 655, 837–838, 938, 939,
949, 964, 970–989
chromium (III) ion colors, 955
chromium (III) oxide, 971
chromium (VI) oxide, 971
cinnabar, 972, 973, 988, 1007
cinnamic acid, 200
cis isomer, 943, 947
cisplatin, 947
citric acid, 726
Clapeyron, Emile, 587
Clausius, Rudolf, 587
Clausius–Clapeyron equation, 587
close-packed structure, 387–389
coal, 100, 101, 654–655
cobalt, 938, 939, 945, 964
cobalt complexes, 947, 951, 952
cobalt(II) chloride, 1009
cobalt(III) chloride, 947
cocaine, 746, 747
coffee, 817
cogeneration, 155
cohesive forces of liquids, 374
colligative properties, 429–432, 429–439
colloidal suspensions, 440
colloids, 440
colours, 953–956, 954
combinatorial chemistry, 506
combustion, 128, 137, 143–144, 1025
common-ion effect, 805–806
common table salt. *See* sodium chloride
competitive electrolysis, 873–874
complementary base pairs, 915
complementary colours, 954
complexation equilibria, 811–818
complex ion, 711. *See also* coordination
complexes
composite model of bonding, 336–338
compounds, 3, 16–18, 16–23, 18–20, 21–22,
131, 240, 1003. *See also* specific types of
compounds
concentrated HCl, 28–29
concentrations, 696–698, 737

- in buffer solutions, 771–773
- calculation example, 24
- changes, 613–615, 690–691
- conversions, 415–416
- effects, 615–617
- electrochemical cell, 861–862
- and entropy, 570–572
- equilibrium, 677, 698–702, 737
- and free energy, 578–581, 682–683
- initial, 696–698, 737
- of ionic solutions, 26–27
- mass percent, 413–414
- molarity, 413–414
- notation shorthand, 24
- partial pressure, 571
- polyatomic ions, 26
- in PPM, 71–72
- quotient, 776
- ratios, 676
- reactants, 644
- and reaction rates, 615–620
- solutions, 23–24, 413–416
- and spontaneity, 580–581
- standard, 680
- symbol for units, 24
- tables, 696–698
- zeroth-order reactions, 627–628
- condensation, 362, 364, 373
 - ionization and reaction path, 237
 - phosphate, 1002–1003
 - polymerization, 896–901
 - reaction, 890–891, 896
- condensed phases, 362
- conductivity and resistance, 381
- conductivity measurements, 740–741
- conductors, 347
- conformations, 484–489
- coniine, 746
- conjugate acid, 727, 751
- conjugate acid–base pairs, 727–728, 771
- conjugate base, 727
- conjugated double bonds, 340–341, 343
- conjugated π systems, 340–341
- conservation law, 31–32
- constant-pressure calorimetry, 135–136
- constant-pressure process, 142
- constant-volume calorimetry, 135, 138
- constraints, 555
- contour drawings of atoms, 192–195
- convection, defined, 90
- conversions, 962, 963
 - atm - bar - Torr, 61
 - bar-Torr-atm, 61
- concentration, 415–416

- mass–mole–atom, 14–15
- mass–mole–number, 21–22
- molar mass (M), use of, 21
- mole, 75–77
- ratios, 8
- stoichiometry and, 35–37
- Torr–atm–bar, 61
- units, 7–8
- wavelength–frequency, 169–170, 184
- coordinate covalent bond, 811
- coordination complexes, 940–948
 - birth, 947–948
 - bonding in, 948–957
 - colour, 953–956
 - crystal field splitting energy, 949, 952–953
 - crystal field theory, 948
 - defined, 940
 - formula of, 946
 - four-coordinate complexes, 942
 - isomers, 942–945
 - ligands, 940, 941
 - magnetic properties, 950–952
 - naming, 945
 - orbital stability in octahedral complexes, 949
 - populating the d orbitals, 949–950
 - spectrochemical series, 952
 - spins, 950, 951
 - square planar complex, 956
 - structures of, 924
 - tetrahedral complex, 956
- coordination number, 924
- copolymers, 893
- copper, 225, 345, 380–381, 421, 939, 967, 973
 - applications, 971–972
 - fireworks, 210
 - hydrocarbon formation, 655
 - metallurgy of, 964
 - orbitals, 194
 - standard molar entropies, 568
- copper–hydrogen cell, 853
- copper(II) hydroxide, 801
- copper(II) sulphate, 842–843
- copper sulphate, 851
- cornstarch, 440
- corrosion, 829, 868–871, 875
- cotton, 902
- coulomb (C), 857
- coupled reactions, 594–595
- covalent bonds, 255
 - angles, 289–290
 - coordinate, 811
 - dipole moments, 290–293
 - length, 293–295
 - polar covalent, 258–259

- polarity, importance of, 291–293
- properties of, 289–298
- types, 129, 376
- cracking, 654
- CRC Handbook of Chemistry and Physics*, 123, 146, 711
- Crick, Francis, 914, 915
- critical point, 398, 400
- crossed molecular beam techniques, 656
- cross-linking, 895, 903, 904
- Crutzen, Paul, 606
- cryolite, 990, 991, 992
- crystal
 - close-packed structure, 387–389
 - cubic close-packed structure, 388
 - field splitting energy, 949, 951–952, 954
 - field theory, 948
 - hexagonal close-packed structure, 388
 - imperfections, 393–394
 - lattice, 384–387
 - liquid crystals, 392–393
- crystalline defects, 393–394
- crystalline lattice, 994
- crystalline solids, 383, 386
- cubic centimetre (cm³), 8
- cubic close-packed structure, 388
- cubic crystals, 384–387
- cuprite, 962, 967
- Curl, Robert F. Jr, 1004
- curved arrows, 511–512
- cyanide, 751
- cyano ligand, 941, 952
- cyclic adenosine monophosphate (cyclic AMP), 2
- cyclic guanosine monophosphate (cGMP), 982
- cycloalkanes, 461, 489
- cyclobutane, 461
- cyclohexane, 417, 418, 419, 461, 462
- cyclohexanol, 374
- 1,3-cyclopentadiene, 462
- cyclopentane, 461
- cyclopropane, 646
- cysteine, 23, 888, 919, 920, 924
- cytidine, 913
- cytochrome, 307, 960, 961
- cytosine, 912, 915, 917

D

- Dacron, 900
- dactylone, 454
- Dalton, John, 166
- Dalton's atomic theory, 31
- Dalton's law of partial pressures, 69–70, 412
- dash–wedge diagram, 485

Davisson, Clinton, 185
d-block elements
 ionizations, 241–242
DDT (dichlorodiphenyltrichloroethane), 1013
de Broglie equation, 184–185, 186
decane, 275, 366, 455
decay constant, 1033
decomposition, 126, 147, 675, 681–682
dehydrohalogenation reaction, 527
delocalized orbitals, 345–346
delocalized ? orbitals, 335–339, 344
 carbon dioxide, 338–339
 composite model of bonding, 336–338
 larger delocalized ? systems, 343–344
 other second-row triatomics, 339
 ozone, and the nature of resonance, 335–338
density, 11, 85–87, 386, 415
deoxyhaemoglobin, 958
deoxyribonucleic acid (DNA), 912
 atomic force microscopy (AFM), 5, 6
 complementary base pairs, 915
 DNA chips, 916–917
 double helix, 914–916, 947
 liquid crystals, 393
 secondary structure, 914–916
deoxyribose, 912
deprotonation, 798
designer drugs, 747
desorption, 654
detergents, 442
dew point, 97
diacid, 897, 898
diamagnetic, 950
diamagnetic atoms, 227
diamine, 898
 1,4-diaminobutane, 473
 1,5-diaminobutane, 473
 2,3-diaminopropanoic acid, 477
diamonds, 347, 378, 381, 567, 887, 1004
diastereomers, 489–490
diatomic molecules, 257, 309–310, 327–329
 bond energies, 128–129
 heteronuclear, 333–335
 homonuclear, 332–333
 second-row, 329–331, 334
diatomic oxygen, molar mass, 19
diazepam, 746
 1,2-dichlorobenzene, 464
 1,3-dichlorobenzene, 464
 1,4-dichlorobenzene, 464
 p-dichlorobenzene, 466
dichlorodiphenyltrichloroethane (DDT), 1013
 1,2-dichloroethane, 1009
 cis-dichloroethene, 481, 490