

Index

- abciximab, 339
 ABO blood group system, 29, 345
 acetylcholine (ACh), 234
 acetylcholine receptors (AChRs),
 234–5, 267–8
 acetylcholinesterase (AChE), 20, 232
 acid
 Brønsted–Lowry definition, 328
 definitions, 328
 strong and weak acids (pK_a), 328–9
 acid–base disorders, 121, 329–30, 336
 acid–base physiology, 330–1, 333–6
 acidaemia, 328
 acidosis, 329–30
 acromegaly, 391
 action potential, 221
 acute high-altitude illness, 427
 acute kidney injury (AKI), 309–10
 acute pancreatitis, 289
 acute respiratory distress syndrome
 (ARDS), 51, 157, 329, 357
 Addison's disease, 326
 adenine (A), 8
 ADP (adenosine diphosphate)
 receptor antagonists, 339
 adrenal glands, 397–400
 adrenaline, 20, 400
 adrenergic receptors (adrenoceptors),
 268
 adrenocorticotrophic hormone
 (ACTH), 384, 389–90
 aerobic metabolism, 64
 ageing, 119, 420–4
 Acquired immunodeficiency
 syndrome (AIDS) patients, 364
 airway devices
 effects on the respiratory system,
 108
 airway resistance, 88–9
 and anaesthesia, 90–1
 albumin, 366–7
 alcohol
 acute binge, 301
 chronic abuse, 301
 metabolism, 301
 aldosterone, 387, 398
 alkalaemia, 328
 alkalosis, 330
 allergens, 355
 allergic reactions, 356
 allergic rhinitis, 363–4
 allodynia, 272
 allopurinol, 301, 310
 altitude physiology, 42, 78–9, 81, 99,
 425–8
 alveolar–arterial (A–a) gradient, 78
 alveolar–capillary barrier, 24, 40, 42–3
 alveolar dead space (V_D^{Alv}), 45–6
 alveolar diffusion, 40–4, 64–5
 rate of diffusion equation, 40
 alveolar gas equation (AGE), 64, 77–9
 alveolar surface tension, 83–4, 88
 alveolar ventilation, 46–8, 69
 alveolar volume (V_A), 45
 alveoli, 24
 cell types, 24
 determining the P_{AO_2} , 77
 aminophylline, 301
 amoxicillin, 410
 anabolism, 369
 anaemia, 351–3
 global oxygen delivery in an
 anaemic patient, 74–5
 anaemic hypoxia, 64
 anaerobic metabolism, 81
 anaesthesia
 and airway resistance, 90–1
 and global oxygen consumption, 76
 and global oxygen delivery, 76
 at altitude, 427–8
 effects of hypoxic pulmonary
 vasoconstriction (HPV), 99–100
 effects on normal thermoregulatory
 mechanisms, 431–2
 effects on the immune system, 364–5
 emergency anaesthesia, 55
 for thyroid surgery, 394–5
 halothane hepatitis, 295–6
 heat loss during, 431–2
 hypercapnoeic acidosis, 329–30
 hypotensive anaesthesia, 149
 low flow anaesthesia, 29
 management in sickle cell disease,
 33
 minimal flow anaesthesia, 29
See also general anaesthesia.
 anaesthetic agents
 negative inotropic effects, 121
 anaesthetic breathing systems
 mechanical dead space, 47–8
 re-breathing effect, 47–8
 anaesthetic drugs
 effects on the respiratory system,
 107–8
 effects on ventilation control, 95
 anaphylaxis, 363–5
 anatomical dead space
 Fowler's method of measurement,
 48
 anatomical shunt, 96
 anaxonic neurons, 184
 angina
 anti-anginal drugs, 157
 anion gap, 330–1
 equation, 330
 anorexia nervosa, 382–3
 Anrep effect, 121
 anterior spinal artery syndrome, 209,
 214
 antiarrhythmic drugs, 253–4
 antibiotics, 195, 364
 antibodies (immunoglobulins),
 358–60, 362–3, 409
 antidiuretic hormone (ADH), 149,
 318, 321, 324, 387, 390–1
 antiemetic drugs, 284
 antifibrinolytic drugs, 344
 antigens, 355
 anti-platelet drugs, 116, 338–40
 aortic stenosis, 122–3
 apneustic centre, 92
 apnoea, 38–9
 test for brainstem death, 52
 arachnoid mater, 188
 area postrema, 195
 arginine vasopressin. *See* antidiuretic
 hormone (ADH)
 arterial baroreceptor reflex, 166–7
 arterial CO_2 tension, 46–8, 66
 arterial pressure wave
 Windkessel effect, 150
 arterial pressure waveform, 150–2
 arterial pulse contour analysis, 152
 arterial system, 144–9
 arterioles, 146–8
 arteriovenous anastomoses, 158
 aspiration pneumonia, 277, 281

- aspirin, 116, 312, 339
asthma, 89, 329, 356, 363–4
astrocytes, 188
atelectasis, 21
 caused by general anaesthesia, 108
ATP (adenosine triphosphate), 5–6, 369, 373
ATPases, 14
atracurium, 424
atropine, 410
autonomic nervous system (ANS), 172, 184–5, 265–8
autonomic neurons, 184–5
autosomal dominant inheritance, 11
autosomal recessive inheritance, 11
autotransfusion, 156
axons, 183
- Bain circuit (Mapleson D), 47
Bainbridge reflex, 166–7
balloon-tipped pulmonary artery catheter, 100
 See also pulmonary artery catheter
Bamford classification of ischaemic stroke, 189
barbiturates, 301
barotrauma, 51
Barrett's oesophagus, 277
basal ganglia of the brain, 186
basal metabolic rate (BMR), 379
base
 Brønsted–Lowry definition, 328
 definitions, 328
base excess, 330
basophils, 356
Bazett's formula, 262
Becker's muscular dystrophy, 242
benzodiazepines, 195, 231, 423
β-blockers, 116, 121
bipolar neurons, 184
bisoprolol, 116
bleomycin-induced oxygen toxicity, 103
bleomycin treatment
 pulmonary fibrosis related to, 103
blood constituents, 366
blood–brain barrier (BBB), 153, 196
blood haematocrit
 influence on cerebral blood flow (CBF), 198
blood oxygen content equation, 28
blood pressure
 diastolic blood pressure (DBP), 148
 in tachycardia, 148
 invasive measurement method, 148
 manipulation in clinical practice, 149
 non-invasive measurement, 148
 systolic blood pressure (SBP), 148
 See also mean arterial pressure (MAP).
blood substitutes (O₂-carrying solutions), 350
blood transfusion
 allogenic transfusion, 346
 autologous transfusion, 346, 349
 blood groups, 29
 blood substitutes (O₂-carrying solutions), 350
 cell salvage, 349
 complications of massive transfusion, 349–50
 cross-match tests, 347
 haemolytic transfusion reaction, 346–7
 infectious disease transmission, 348
 iron overload (haemosiderosis), 348
 massive transfusion, 349–50
 O₂ binding in transfused blood, 32
 potential complications, 348
 storage of blood products, 347–8
 universal donor, 347
 universal recipient, 347
blood velocity and flow equation, 142
body
 compartments, 316
 general organization, 1–4
 organs, 1
 systems, 1–2
body plethysmography
 calculation of FRC, 53–4
Bohr effect, 37
Bohr equation, 45, 49
Bohr method
 measurement of physiological dead space, 49
bone disease
 and kidney dysfunction, 397
 and liver dysfunction, 397
bone mineral density
 effects of weight-bearing exercise, 182
botulinum toxin, 234
Bowditch effect, 122
Boyle's law, 53–4
brain, 184
 cerebral arterial blood supply, 188–9
 electroencephalogram (EEG), 189–90
 extrapyramidal system, 186
 stroke, 189
 venous drainage, 189
 ventriculomegaly, 192
brain anatomy, 186–7
 basal ganglia, 186
 cerebellum, 187
 cerebral cortex, 186
 cerebral hemispheres, 186
 corpus callosum, 186
 diencephalon, 186–7
 embryological classification, 187
 frontal lobe, 186
 hypothalamus, 186–7
 lateral geniculate nucleus, 187
 limbic system, 186
 medial geniculate nucleus, 187
 medulla oblongata, 187
 meninges, 187–8
 mesencephalon (midbrain), 187
 metathalamus, 187
 occipital lobe, 186
 parietal lobe, 186
 pons, 187
 prosencephalon (forebrain), 187
 rhombencephalon (hindbrain), 187
 subthalamus, 187
 telencephalon (cerebrum), 186
 temporal lobe, 186
 thalamus, 186
 Wernicke's area, 186
brain injury
 primary, 204
 secondary, 204
 See also traumatic brain injury
brainstem death testing
 apnoea test, 52
bronchial circulation, 96
 and lung transplant surgery, 96
Brønsted–Lowry definitions of acid and base, 328
Brown-Séquard syndrome, 210, 214
butyrylcholinesterase, 20
- calcitonin, 397
calcium (Ca²⁺) in the body, 219–20, 395–7
calcium channel blockers, 116, 121
calcium resonium, 327
capillaries, 153–6
capillary–tissue exchange, 153–4
carbamazepine, 301
carbaminohaemoglobin, 37
carbohydrates
 digestion and absorption, 287
carbon dioxide (CO₂)
 Bohr effect, 37
 diffusion rate, 40
 Haldane effect, 37
 methods of transport in the circulation, 36–7
 physiological effects of apnoea, 38–9
 production and storage, 36

Index

- carbon dioxide (CO₂) (cont.)
proportion in each transport form, 37–8
- carbon dioxide (CO₂) arterial partial pressure
effects on cerebral blood flow, 198
- carbon dioxide (CO₂) dissociation curve, 38–9
- carbon monoxide
carboxyhaemoglobin, 32
diffusion rate, 41–2
effects on O₂-carrying capacity, 34
lung diffusion capacity (DLCO), 43
- carboxyhaemoglobin, 32
- cardiac action potential
action of the pacemaker currents, 255
conduction through the heart, 255–6
differences from nerve action potential, 250–1
pacemaker cells, 254–5
pacemaker potential, 255
phases, 251–3
refractory periods, 253
- cardiac arrhythmias, 161, 253–4
- cardiac cycle
definition, 117
events, 117–19
phases, 117
- cardiac failure, 130–4, 139–40
- cardiac index (CI), 122
- cardiac muscle
contraction mechanism, 256–7
excitation–contraction coupling, 256
function, 130
functional syncytium, 112
influence of the autonomic nervous system, 257–8
resting membrane potential (RMP) in cells, 250
structural features, 250
termination of contraction, 257
- cardiac output (CO)
Bowditch effect, 122
calculation from the arterial pressure waveform, 152
cardiac index (CI), 122
definition, 120
effects of ageing, 119
effects of aortic stenosis, 122–3
ejection fraction (EF), 119
factors affecting stroke volume (SV), 120
influence of afterload, 120–1
influence of heart rate (HR), 121
influence of myocardial contractility, 120–1
influence of preload, 120–1
myocardial ischaemia, 121
regulatory factors, 120–1
relationship to mean arterial pressure (MAP), 122
cardiac output (CO) equation, 120
cardiac output (CO) measurement
invasive methods, 123–7
methods based on the Fick principle, 123–6
methods of measurement, 123
minimally invasive methods, 127–9
pulse contour analysis, 126–7
cardiac resynchronization therapy (CRT), 114
cardiac toxicity
effects of local anaesthetics, 258
cardiac work
relationship to left ventricular pressure–volume loop, 137–8
cardiogenic pulmonary oedema, 99
cardiogenic shock, 149
cardiopulmonary bypass, 335
cardiovascular reflexes
arterial baroreceptor reflex, 166–7
Bainbridge reflex, 167
classes of haemorrhagic shock, 169
classification, 166
consequences of peripheral chemoreceptor activation, 167–8
Cushing's reflex, 167
decompensated shock, 169
physiological response to haemorrhage, 168–9
cardiovascular system
components, 1, 141
effects of exercise, 176–8
effects of physical training, 182
effects of the Valsalva manoeuvre, 171
See also pulmonary circulation; systemic circulation
catabolism, 369
production of ATP, 369
catalysts, 18
catecholamines, 194–5, 312, 387, 399–400
cauda equina syndrome, 214
cell
basic structure, 5
organelles, 5–7
cell membrane, 5
active transport across, 16
carriers, 14
cholesterol, 13
endocytosis, 17
enzymes, 14
exocytosis, 17
functions of transmembrane proteins, 13–14
glycolipids, 13
glycoproteins, 13
ion channels, 14
mechanisms of transport across, 14–17
passive transport across, 15–16
peripheral proteins, 13
pumps (ATPases), 14
receptors, 14
structure, 13
transcytosis, 17
transmembrane proteins, 13
transport of hydrophilic substances across, 14–17
transport of lipophilic substances across, 14
vesicular transport across, 17
cell nucleus, 5
cell salvage for autologous transfusion, 349
cellular respiration, 369
central cord syndrome, 214
central nervous system (CNS), 184
brain, 184
neuroglia, 188
oxygen toxicity effects, 102
spinal cord, 184
central venous cannulation, 164–5
central venous oxygen saturation (S_{cv}O₂), 163
central venous pressure (CVP), 161–3
central venous pressure (CVP) waveform, 161
centrilobular necrosis of the liver, 295–6
cerebellum, 187
cerebral arterial blood supply, 188–9
cerebral autoregulation, 197
cerebral blood flow (CBF)
cerebral autoregulation, 197
cerebral perfusion pressure (CPP), 197
effects of anaesthetic drugs, 198–200
effects of CO₂ arterial partial pressure, 198
effects of low CBF on neurons, 197–8
effects of O₂ arterial partial pressure, 198

- factors affecting global CBF, 198
 flow–metabolism coupling, 198
 influence of blood haematocrit, 198
 measurement, 197
 methods of measurement, 200
 normal level, 197
 proportion of cardiac output (CO), 197
- cerebral blood supply
 stroke, 189
- cerebral cortex, 186
 voluntary control of breathing, 94
- cerebral hemispheres, 186
- cerebral perfusion pressure (CPP), 197
- cerebrospinal fluid (CSF), 191–2
- cerebrum (telencephalon), 186
- Charcot–Marie–Tooth disease, 235
- chemoreceptors
 central, 93
 peripheral, 92–3
- choroid plexus, 195
- chromosomes, 8
- chronic obstructive pulmonary disease (COPD), 53, 89–90, 93, 99–100, 105–6, 329
- chyle, 164
- chylomicrons, 164
- chylothorax, 165
- ciclosporin, 301
- cimetidine, 301
- circle of Willis, 188–9
- circle system (anaesthetic breathing system), 47
- circulatory system, 1
- circumventricular organs, 195–6
- citric acid cycle, 369, 371–2
- clopidogrel, 116, 339
- closing capacity (CC), 55
- clotting
 laboratory tests, 341–3
- coagulation
 cell-based model, 341
- coagulation cascade, 338–41
- cocaine, 232
- codeine, 301
- codons, 10
- coenzymes, 19–20
- cofactors, 19–20
- compensated heart failure, 132–3
- complement system, 357–8
- complex regional pain syndrome (CRPS), 273
- compliance
 of the venous system, 158–9
- congestive heart failure, 156
- Conn’s syndrome, 327
- contact dermatitis, 364
- continuous positive airway pressure (CPAP), 100
- cor pulmonale, 99
- coronary blood flow, 114–16
- coronary circulation, 112–13
- corpus callosum, 186
- corticospinal tract, 211–12
- corticotropin-releasing hormone (CRH), 389
- cortisol, 386–7, 398–9
- creatinine, 312
- critical illness
 causes of peripheral oedema, 156
 complex acid–base disturbance, 336
 global oxygen delivery, 76
 hyperglycaemia, 385
 hypoalbuminaemia, 156
 myopathy, 242
 risk associated with etomidate, 399
- Cushing’s disease, 391, 398
- Cushing’s reflex, 167, 202–3
- cyanide poisoning, 32, 34–5
- cyanohaemoglobin, 32
- cyclizine, 284
- cyclo-oxygenase (COX) inhibitors, 339
- cystic fibrosis, 10
- cytochrome P450 enzymes, 20
- cytoplasm, 5
- cytosine (C), 8
- cytotoxic hypoxia, 64
- cytotoxic T-cells (CD8+ T-cells), 361–2
- Dalton’s law, 425
- dantrolene, 240
- Darcy’s law, 97, 122, 145, 147
- decompensated heart failure, 133–4
- decompensated shock, 169
- demyelinating disease, 224
- dendrites, 183
- denervation hypersensitivity, 235
- deoxyhaemoglobin, 30, 37
- desmopressin (DDAVP), 341
- diabetes insipidus, 321
- diabetes mellitus, 312
- diabetic autonomic neuropathy, 172
- diabetic ketoacidosis, 374, 378
- diamorphine, 195
- diarrhoea
 oral rehydration therapy (ORT), 287
- diastolic blood pressure (DBP), 148
- diencephalon, 186–7
- dietary nutrients
 carbohydrate digestion and absorption, 287
 lipid digestion and absorption, 288
 main classes, 287
 protein digestion and absorption, 287–8
- DiGeorge syndrome, 358
- digestion
 role of the lymphatic system, 164
- digestive system, 2
- digoxin, 121–2, 366
- dipyridamole, 339–40
- dissociated sensory loss, 210–11
- disulfiram, 301
- diuretics, 324
- diving
 airway resistance, 89
 ambient pressure change during descent, 429
 breath-hold and SCUBA compared, 430
 decompression sickness, 430
 effects on air within lungs on a breath-hold dive, 429–30
 physiology of a body during head-out immersion, 429
 risk of oxygen toxicity, 102–3
- diving reflex, 429
- DLCO (lung diffusion capacity for carbon monoxide), 43–4
- DNA (deoxyribonucleic acid), 5, 8–9
- dobutamine, 121, 149
- domperidone, 284
- L-DOPA, 194–5, 399
- dopamine, 20, 389
- dorsal respiratory group (DRG) of neurons, 92
- double-lumen endotracheal tubes (DLETTs), 23
- doxapram, 95
- drug metabolism
 inter-patient variability, 301
 processes in the liver, 301
- drugs
 effects on ventilation control, 95
 transport across the blood–brain barrier (BBB), 195
- Duchenne’s muscular dystrophy, 242
- duodenal ulcers, 281
- dura mater, 187–8
- ectoderm, 1
- eicosanoids, 309, 357, 387
- Einhoven’s triangle, 113
- ejection fraction (EF) equation, 119
- electrocardiogram (ECG), 113–14, 117, 261–4
- electroencephalogram (EEG), 189–90
- electrolytes, 2, 121, 219–20
- electron transport chain, 369, 372–3
- Embden–Meyerhof pathway, 369–70
- endocrine signalling, 183

Index

- endocrine system
 components, 2
 effects of the stress response, 384–5
- endoderm, 1
- endoplasmic reticulum (ER), 6–7
- endothelin (ET), 157
- endothelium functions, 156–7
 anticoagulant properties, 157
 haemostasis, 157
 inflammatory system, 157
 procoagulant properties, 157
 synthesis of vasoactive substances, 157
- endotracheal tubes (ETTs), 91
 choice for children, 416–17
- enoximone, 121
- enteric nervous system, 184
- enteric neurons, 184
- enzymes
 catalysis, 18
 coenzymes, 19–20
 cofactors, 19–20
 definition, 18
 hydrolases, 19
 importance in anaesthetic practice, 20
 isomerases, 19
 ligases, 19
 lyases, 19
 main features, 18
 mode of action, 18
 oxidoreductases, 19
 regulation of biochemical pathways, 18
 specificity, 18
 transferases, 19
 types of, 19
- eosinophils, 356
- ependymal cells, 188
- ephedrine, 423
- epidural anaesthesia, 386
- erythromycin, 301
- erythropoiesis, 29, 351
- erythropoietin (EPO), 351
- esmolol, 149
- etomidate, 231, 386, 399
- excess post-exercise oxygen
 consumption (EPOC), 181–2
- excitation–contraction coupling
 cardiac muscle, 256
 skeletal muscle, 239
 smooth muscle, 247–8
- exercise
 effects on RBC transit time, 42
 effects on venous return, 160
 hypoxaemia induced by, 42
- exercise physiology
 changes with physical training, 182
- dynamic exercise, 174
- effects on bone mineral density, 182
- effects on skeletal muscle, 176
- effects on the cardiovascular system, 176–8
- effects on the respiratory system, 178–9
- effects on thermoregulation, 179
- elite athletes, 182
- excess post-exercise oxygen
 consumption (EPOC), 181–2
 meaning of $\dot{V}O_{2\max}$, 179–80
 muscle fatigue, 175
- O₂ consumption after exercise, 181–2
- oxygen debt, 181–2
- physiological challenges of exercise, 174
- physiological changes in
 anticipation of exercise, 175–6
- skeletal muscle energy sources, 175
- skeletal muscle fibre types, 174–5
- static exercise, 174
- expiratory flow–volume curve, 58–60
- expiratory reserve volume (ERV), 50
- extracellular fluid (ECF) volume
 regulation by the kidneys, 316–17
- extrapyramidal system, 186
- factor VIII, 341
- Fahraeus–Lindqvist effect, 145
- farmer's lung, 364
- fats
 metabolism, 374
- fentanyl, 386
- fetal haemoglobin (HbF), 32
- fetal physiology
 causes of fetal distress, 411–12
 circulation, 99
 double Haldane effect, 411
 features of the fetal circulation, 412
 features of the fetal respiratory system, 414
- fetal cardiovascular reflexes during
 labour, 412–14
- functions of the placenta, 408
- mechanisms for transfer across the
 placenta, 409–10
- oxygen delivery, 410–11
- oxygenation during labour, 411–12
- physiological changes at birth, 414–15
- placental anatomy related to
 function, 408–9
- placental antibody transfer, 409
- placental development, 408–9
- placental drug transport, 410
- pre-eclampsia, 408–9
 reversion to a transitional
 circulation, 415
- fibrinogen, 366
- fibrinolysis pathway, 343–4
- Fick's law, 28, 40
- flail chest, 329
- flavin adenine dinucleotide (FAD), 369
- flow–metabolism coupling, 198
- flow–volume curve, 60–1
- flow–volume loop, 60–1
- fluid balance
 role of the lymphatic system, 164
- fluid management, 162–3
- follicle-stimulating hormone (FSH), 387, 389–90
- forced spirometry, 56–7
 expiratory flow–volume curve, 58–9
- forebrain (prosencephalon), 187
- Fowler's method, 45
 measurement of anatomical dead
 space, 48
 measurement of closing capacity
 (CC), 55
- Frank–Starling mechanism, 121, 130
- frontal lobe of the brain, 186
- functional magnetic resonance
 imaging (fMRI)
 measurement of CBF, 200
- functional residual capacity (FRC), 50
 calculation using body
 plethysmography, 53–4
 calculation using gas dilution,
 52–3
 calculation using multiple breath
 nitrogen washout method, 54–5
- factors affecting FRC volume, 51–2
- importance in emergency
 anaesthesia, 55
- importance of, 51
- pre-oxygenation for general
 anaesthesia, 52
- ganglia (PNS), 183
- gas dilution technique, 52–3
- gastric dumping syndrome, 282
- gastric ulcers, 281
- gastrointestinal (GI) tract
 organs involved in digestion, 286
- gastro-oesophageal reflux disease
 (GORD), 277–8, 281
- general anaesthesia
 atelectasis caused by, 108
 effects of airway devices, 108
 effects on lung volumes, 108
 effects on the lungs, 108–9
 postoperative effects on lung
 function, 109–10

- ventilation–perfusion mismatch, 109
See also anaesthesia.
- general anaesthetics
 mechanisms of action, 230–2
- genetic mutations, 10
- genetics
 chromosomes, 8
 codons, 10
 Mendelian inheritance patterns, 10–12
- germ cell layers, 1
- Glasgow coma score (GCS), 204
- global oxygen consumption, 74
 and anaesthesia, 76
- global oxygen delivery
 anaemic patient, 74–5
 anaerobic threshold, 75–6
 and anaesthesia, 76
 critically ill patient, 76
 definition, 74
 typical resting global oxygen delivery, 74–5
- globulins, 366
- glomerular filtration rate (GFR), 313–15
- glucagon, 121, 377–9
- gluconeogenesis, 377
- glyceryl trinitrate, 116, 149, 157
- glycolysis, 369–70
- glycoprotein IIb/IIIa inhibitors, 339
- glycopyrrolate, 410
- glymphatic system, 191
- Goldman–Hodgkin–Katz equation, 218
- Golgi apparatus, 7
- Golgi tendon organs, 243
- gonadotropin-releasing hormone (GnRH), 389
- Goodpasture's disease, 309, 364
- graft-versus-host disease
 in blood transfusion, 348
- Graham's law, 40
- Graves' disease, 394
- growth hormone (GH), 376, 389–90
- growth-hormone-releasing hormone (GHRH), 389
- guanine (G), 8
- Guillain–Barré syndrome, 57–8, 224, 329
- haemochromatosis, 353
- haemoglobin
 carboxyhaemoglobin, 32
 cooperative binding of oxygen, 30
 cyanohaemoglobin, 32
 effects of carbon monoxide poisoning, 34
 fetal haemoglobin (HbF), 32
 HbA form, 32
 HbA₂ variant, 32
 HbS in sickle cell disease, 32
 methaemoglobin, 32
 methaemoglobin clinical significance, 33–4
 oxyhaemoglobin dissociation curve, 30–2
 single point mutation in sickle cell disease, 32–3
 structure, 29
 types of, 32
- haemophilia, 341
- haemorrhage
 physiological responses, 156, 168–9
- haemorrhagic shock, 169
- haemostasis
 anti-platelet drugs, 338–40
 cell-based coagulation model, 341
 coagulation cascade, 338–41
 coagulation disorders, 341
 components involved, 337
 definition, 337
 fibrinolysis pathway, 343–4
 functions of the endothelium, 157
 haemostatic response, 337
 inhibition of fibrinolysis, 344
 initiation, 337–8
 laboratory tests of clotting, 341–3
 platelet activation and aggregation, 338
 role of the vascular endothelium, 337
 steps in clot formation, 337
 thromboelastography, 343
 thrombolysis, 343–4
- Hagen–Poiseuille equation, 89, 144–6
- Haldane effect, 37–8, 411
- halothane hepatitis, 295–6
- haptens, 355
- head injury
 classification systems, 204
- heart
 blood flow to the myocardium, 114
 functions, 111
 influence of the autonomic nervous system, 257–8
 structure, 111
 venous drainage, 113
- heart failure, 130–4, 139–40
- heart rate (HR), 261
- heart transplant, 258–60
- Henderson–Hasselbalch equation, 329–30
- Henry's law, 28
- hepatopulmonary syndrome, 65
- hepcidin, 353
- hexose monophosphate shunt, 377
- hindbrain (rhombencephalon), 187
- His–Purkinje system, 117
- homeostasis, 2–4
- homeostatic control mechanisms, 3–4
- hormones, 387
 classification, 387
 released by the pituitary gland
 posterior lobe, 390–1
 secreted by the hypothalamus, 389
 secreted by the pituitary gland
 anterior lobe, 389–90
 synthesized by the thyroid gland, 392
- Hudson mask, 47
- Hüfner's constant, 28
- human genome project, 8
- humidification of inspired gases, 22
- Huntingdon's disease, 10
- hyaline membrane disease, 414
- hydrocephalus, 192
- hydrogen peroxide (H₂O₂), 102
- hydrolases, 19
- hydroxyl free radicals (OH[•]), 102
- hyoscine, 284
- hyperalgesia, 271–2
- hypercapnoea, 94
- hyperglycaemia, 312
- hyperkalaemia, 219, 326–7
- hypersensitivity, 363–4
- hyperthyroidism, 394
- hyperventilation, 46–7, 94
- hypervolaemia, 324–5
- hypoalbuminaemia, 156
- hypokalaemia, 219, 327
- hypomagnesaemia, 327
- hyponatraemia, 219, 318
- hypotension, 149
- hypotensive anaesthesia, 149
- hypothalamic–pituitary axis, 389
- hypothalamus, 186–7, 195, 387–9
- hypothermic cardiopulmonary bypass, 335
- hypothyroidism, 394
- hypotonicity, 318
- hypoventilation, 64, 78, 81
- hypovolaemia, 152, 323–4
- hypoxaemia, 42, 64–5, 71, 94
- hypoxaemic hypoxia, 64
- hypoxia, 64–5
- hypoxic pulmonary vasoconstriction (HPV), 98–100
- hysteresis, 85

Index

- idiopathic thrombocytopenic purpura, 364
 IgA nephropathy, 310
 immune complex disease, 364
 immune system
 active immunity, 360
 adaptive immune system, 355, 358–60
 antibodies (immunoglobulins), 358–60, 362–3
 cell-mediated immunity, 361–2
 complement system, 357–8
 components, 2
 cytotoxic T-cells (CD8+ T-cells), 361–2
 definition of allergen, 355
 definition of antigen, 355
 definition of hapten, 355
 development of antibodies to RBC antigens, 345–6
 effects of anaesthesia and surgery, 364–5
 hypersensitivity, 363–4
 inflammation, 356–7
 innate immune system, 355
 lymphocytes, 358
 lymphoid tissue, 358
 passive immunization, 361
 primary immune response, 358–60
 role of eicosanoids, 357
 role of kinins, 357
 role of the lymphatic system, 164
 secondary immune response, 360
 white blood cells (leucocytes)
 involved in the immune response, 355–6
 immunodeficiency classification, 363
 immunoglobulins (Igs), 362–3, 366
 See also antibodies
 infant respiratory distress syndrome (IRDS), 84, 88, 414
 inflammation, 356–7
 inspiratory capacity (IC), 50
 inspiratory reserve volume (IRV), 50
 insulin, 377–9, 387
 integumentary system, 2
 intensive care
 risks related to oxygenation, 103
 internal carotid arteries, 188–9
 intra-aortic balloon pump, 149
 intracranial pressure (ICP)
 Cushing's triad, 202–3
 definition, 201
 factors influencing, 201–2
 methods of measurement, 201
 Monro–Kellie hypothesis, 201–2
 normal range, 201
 raised, 21–2
 signs and symptoms of raised pressure, 202
 ways to reduce, 203–4
 ion channels, 14
 ionotropic receptors, 229–30
 iron
 control of iron homeostasis, 353
 handling in the body, 352–3
 iron overload (haemosiderosis)
 related to blood transfusion, 348
 irritant receptors, 94
 ischaemic heart disease, 121
 isomerases, 19
 isoniazid, 301
 isoprenaline, 121

 jaundice, 299–300
 Jehovah's Witnesses, 349–50
 Jendrassik manoeuvre, 245
 jugular bulb catheterization, 200
 juxtacapillary receptors (J-receptors), 94

 ketamine, 231, 410
 ketone bodies, 374
 Kety–Schmidt technique, 200
 kidney
 actions of diuretics, 324
 active secretion of waste products, 312
 acute interstitial nephritis, 310
 acute tubular necrosis (ATN), 309
 anatomy, 305
 clearance of drugs from the blood, 312
 effects of ADH, 318
 effects of Starling filtration forces, 156
 filtration fraction, 315
 filtration process, 311
 functions, 305
 generation of high osmolarity in the renal medulla, 319–20
 GFR as indicator of kidney function, 314
 glomerular filtration rate (GFR), 313–14
 glomerulonephritis, 309–10
 handling of urea, 322
 histology, 305–7
 influence of eicosanoids on blood flow, 309
 influence of
 renin–angiotensin–aldosterone axis on blood flow, 308–9
 juxtaglomerular apparatus, 307
 measurement of renal blood flow, 310
 mechanism of ADH action on, 318
 nephron structure and function, 305–7
 pathophysiology of acute kidney injury (AKI), 309–10
 reabsorption from tubular fluid, 311
 reabsorption limit in hyperglycaemia, 312
 regulation of renal blood flow, 307
 regulation of extracellular fluid volume, 316–17
 regulation of Na⁺ excretion, 322
 regulation of plasma volume, 316–17
 renal autoregulation, 307
 renal autoregulation mechanism, 307–8
 renal clearance definition, 313
 renal clearance equation, 313
 renal replacement therapy (RRT), 314–15
 renal transplant, 315
 role in regulation of plasma K⁺ concentration, 325–6
 Starling forces and the GFR, 313
 use of clearance in GFR measurement, 314
 kidney dysfunction
 and bone disease, 397
 kinins, 357
 knee-jerk reflex, 244–5
 Krebs cycle. *See* citric acid cycle

 labetalol, 149
 lactic acidosis, 370–1
 Laplace's law, 83
 laryngeal mask airway (LMA), 91
 larynx, 21
 lateral geniculate nucleus, 187
 lateral medullary syndrome, 211
 left ventricular pressure–volume loop, 135–40
 ligases, 19
 limbic system, 94, 186
 lipase inhibitors, 288
Listeria monocytogenes, 409
 liver
 blood supply, 292
 centrilobular necrosis, 295–6
 halothane hepatitis, 295–6
 intraoperative liver blood flow, 293
 living donor transplantation, 297
 macroscopic anatomy, 293
 main cell types, 294–5
 microscopic anatomy, 293–4

- physiological reserve, 297
regeneration capability, 297
regulation of hepatic blood flow, 292
respiratory cycle influence on venous blood flow, 292–3
- liver dysfunction
and bone disease, 397
- liver function
classification of functions, 297
drug metabolism, 301
endocrine functions, 300
exocrine functions, 298–9
factors affecting drug metabolism, 301
immunological functions, 300
jaundice, 299–300
liver function tests, 302–3
metabolic functions, 297–8
physiological changes in cirrhosis, 302
physiological functions, 301–2
substances synthesized by the liver, 300–1
testing in paracetamol overdose, 303
- liver transplantation criteria, 303
- local anaesthetics
action on nerve axons, 185
forms of toxicity, 258
placental transfer, 410
response of different types of nerve fibre, 225–6
- Lorraine Smith effect, 102
- low flow anaesthesia, 29
- lung capacities
closing capacity (CC), 55
distinction from lung volumes, 50
functional residual capacity (FRC), 50–2
inspiratory capacity (IC), 50
methods of measurement, 52
total lung capacity (TLC), 50
vital capacity (VC), 50
- lung compliance
component of respiratory compliance, 82
definition, 82
dynamic compliance, 84–5
effects of surface tension in alveoli, 83–4
effects of surfactant, 83–4
factors affecting, 82
measurement, 85
mechanism of pulmonary surfactant action, 84
static compliance, 84–5
- lung diffusion capacity for carbon monoxide (DLCO), 43–4
- lung resection, 43–4
preoperative work using spirometry, 61–3
- lung transplantation
and the bronchial circulation, 96
- lung ventilation
regional differences in, 85–7
static compliance curve, 85–7
- lung volumes
distinction from lung capacities, 50
effects of general anaesthesia, 108
expiratory reserve volume (ERV), 50
inspiratory reserve volume (IRV), 50
methods of measurement, 52
residual volume (RV), 50
tidal volume (V_T), 50
tidal volume in mechanically ventilated patients, 51
- lungs
alveolar dead space (V_D^{Alv}), 45–6
alveolar volume (V_A), 45
anatomical dead space (V_D^{Anat}), 45
anatomy, 23
atelectasis caused by general anaesthesia, 108
causes of pulmonary oedema, 156
components of tidal volume (V_T), 45
defence mechanisms, 25–7
definition of dead space (V_D), 45
definition of dead-space ventilation, 46
effects of general anaesthesia, 108–9
effects of gravity on perfusion, 69
effects of physical training, 182
endocrine functions, 27
immunological functions, 25–7
inflation and deflation during tidal breathing, 24–5
metabolic functions, 27
non-respiratory functions, 21, 25–7
oxygen toxicity effects, 102
physiological dead space (V_D^{Phys}), 45
pneumothorax, 25
postoperative effects of general anaesthesia, 109–10
pulmonary circulation, 27
respiratory functions, 21
types of dead space, 45
vascular functions, 27
West zones, 72–3
- luteinizing hormone (LH), 387, 389–90
- lyases, 19
- lymph fluid, 164
- lymphatic system, 164
- lymphocytes, 164, 358
- lymphoid tissue, 358
- lysosomes, 7
- macrophages, 356
- malignant hyperthermia, 239–40
- mannitol, 195
- mast cells, 356, 358, 363–4
- mean arterial pressure (MAP), 120, 148
arterial baroreceptor reflex, 166–7
Bainbridge reflex, 167
classes of haemorrhagic shock, 169
classification of cardiovascular reflexes, 166
consequences of peripheral chemoreceptor activation, 167–8
Cushing's reflex, 167
decompensated shock, 169
effects of the Valsalva manoeuvre, 171
importance of minimizing fluctuations, 166
manipulation in clinical practice, 149
physiological response to haemorrhage, 168–9
relationship to cardiac output (CO), 122
- mean arterial pressure (MAP)
equation, 122
- mechanical ventilation, 51
- mechanoreceptors, 93–4
- medial geniculate nucleus, 187
- medulla oblongata, 187
area postrema, 195
- melatonin, 195
- Mendelian inheritance patterns, 10–12
- Mendelson's syndrome, 278
- meninges, 187–8
- meningitis, 195
- mesencephalon (midbrain), 187
- mesoderm, 1
- metabolic acidosis, 326, 330
- metabolic alkalosis, 330
- metabolic equivalent (MET), 379
- metabolism
aerobic and anaerobic generation of ATP, 373–4
ATP generated from a molecule of glucose, 373–4
basal metabolic rate (BMR), 379
catabolism of carbohydrates, fats and proteins to ATP, 369
cellular respiration, 369
citric acid cycle, 369, 371–2
definition, 369
effects of glucagon, 377–9
effects of insulin, 377–9
electron transport chain, 369, 372–3

Index

- metabolism (cont.)
fats, 374
gluconeogenesis, 377
glycolysis, 369–70
lactic acidosis, 370–1
pentose phosphate pathway (PPP), 377
production of ketone bodies, 374
protein catabolism, 374
storage and release of nutrients, 374–7
- metabotropic receptors, 232
metaraminol, 149
metarterioles, 156
metastases and the lymphatic system, 164
metathalamus, 187
metformin, 370–1
methaemoglobin, 32–4
methotrexate, 195
microglia, 188
midbrain (mesencephalon), 187
minimal flow anaesthesia, 29
minute ventilation, 46
mitochondria, 5–6
mivacurium, 20, 424
molarity, 317
monoamine oxidase (MAO), 20
monoamine oxidase (MAO) inhibitors, 20
monocytes, 356
Monro–Kellie hypothesis, 201–2
morphine, 195, 312
motor (efferent) neurons, 184
motor units, 241
multiple breath nitrogen washout method, 54–5
multiple sclerosis, 224
multipolar neurons, 184
muscarinic ACh receptors, 268
muscle relaxants, 234, 364, 410, 419, 424
muscle spindles, 243
muscle tone, 245–6
muscular system, 1
myasthenia gravis (MG), 105, 234–5, 329
Mycobacterium tuberculosis infection, 364
myelin, 183, 188
myelinated nerve axons, 185
effects of demyelinating disease, 224
effects on propagation of nerve action potential, 224
myocardial blood flow, 114
myocardial contractility
information from the arterial pressure waveform, 152
myocardial ischaemia, 121
changes in ECG, 113–14
myocarditis, 121
myoglobin, 35
myotonia congenita, 242
myotonic dystrophy, 242
- Na⁺ (sodium) in the body, 219, 322–3
Na⁺/K⁺-ATPase
contribution to resting membrane potential, 218–19
naloxone, 169
natural killer (NK) cells, 356
near-drowning cases
loss of pulmonary surfactant, 84
negative-feedback loops, 3–4
neostigmine, 20
Nernst equation, 218
nerve action potential
definition, 221
effects of demyelinating disease, 224
effects of myelination on propagation, 224
events leading to, 221
propagation along nerve axons, 222–4
refractory period, 226–7
nerve fibres, 185
functional classification, 224–5
response of different types to local anaesthetics, 225–6
nervous system
central nervous system (CNS), 184
component systems, 184–5
components, 1
functions, 183
motor output, 183
peripheral nerve structure, 185
peripheral nervous system (PNS), 184–5
sensory input, 183
sensory integration by the CNS, 183
signalling systems, 183
neural signalling, 183
neuraxial blockade, 149
neuroglia, 188
neuromuscular junction (NMJ), 183, 232–4
neurons
autonomic, 184–5
enteric, 184
morphologic classes, 184
motor (efferent), 184
of the CNS, 188
sensory (afferent), 183
signalling systems, 183
structure, 183–4
neuropathic pain, 272–3
- neurotransmitters, 228–9
ionotropic receptors, 229–30
metabotropic receptors, 232
release at the synaptic cleft, 229
reuptake inhibitors, 232
termination of neurotransmission, 232
neutrophils, 355–6
nicorandil, 116
nicotinamide adenine dinucleotide (NAD⁺), 369
nicotinic ACh receptors, 267–8
nifedipine, 116
nitrate drugs, 116
nitric oxide (NO), 157
nitric oxide synthase (NOS), 157
nitrous oxide (N₂O), 41–2, 231–2
nociception
distinction from pain, 269
nociceptive pain, 269
nociceptor nerve fibres, 269
nociceptors, 269
non-steroidal anti-inflammatory drugs (NSAIDs), 309–10, 366–7
noradrenaline, 20, 149, 400
nuclei (CNS), 183
nucleobases, 8
nutrients
control in the body, 2
- obesity, 88
obesity hypoventilation syndrome, 329–30
obstructive lung disease, 90
occipital lobe of the brain, 186
oesophageal phase of swallowing, 276–7
oesophagus
functional anatomy, 277
gastro-oesophageal reflux disease (GORD), 277–8
oestrogen, 387
olanzapine, 301
oligodendrocytes, 188
omeprazole, 281, 301
ondansetron, 284
one-lung ventilation
and PEEP, 100
opioid drugs, 386, 410
perioperative effects, 365
respiratory depression, 95, 329
oral contraceptive pill, 301
oral phase of swallowing, 276
oral rehydration therapy (ORT), 287
organs
components of body systems, 1–2
development, 1
Orlistat, 288
osmolality, 317

- osmolar gap equation, 317
 osmolarity, 317
 osteoporosis, 397
 oxidoreductases, 19
 oxygen (O₂)
 cooperative binding to
 haemoglobin, 30
 ROS role in normal body functions,
 102
 oxygen arterial partial pressure
 effects on cerebral blood flow, 198
 oxygen binding
 myoglobin structure and properties,
 35
 oxygen-carrying capacity
 effects of carbon monoxide
 poisoning, 34
 oxygen-carrying solutions (blood
 substitutes), 350
 oxygen cascade
 anaerobic metabolism, 81
 definition, 80
 effects of high altitude, 81
 effects of hypoventilation, 81
 effects of pneumothorax, 81
 Pasteur point, 81
 steps along, 80–1
 oxygen consumption
 after exercise, 181–2
 compared with oxygen stores, 28–9
 meaning of $\dot{V}O_{2\max}$, 179–80
 $\dot{V}O_{2\max}$ and surgical risk, 180–1
 oxygen debt, 181–2
 oxygen diffusion
 compared with gases related to
 anaesthesia, 41–2
 compared with other gases, 41
 rate compared with CO₂, 40
 oxygen extraction ratio (OER), 75
 oxygen flux equation, 74
 oxygen levels
 physiological effects of apnoea, 38–9
 oxygen partial pressure
 regulation in the body, 2
 oxygen stores
 compared with oxygen
 consumption, 28–9
 oxygen toxicity
 antioxidants, 102
 CNS toxicity, 102
 effect on the retina, 102
 harmful effects on the body, 102
 harmful levels of oxygen, 102–3
 induced by bleomycin, 103
 Lorraine Smith effect, 102
 lung toxicity, 102
 mechanism, 102
 oxygenation in intensive care, 103
 Paul Bert effect, 102
 protection against oxidative stress,
 102
 reactive oxygen species (ROS), 102
 risk for divers, 102–3
 oxygen transfer
 diffusion limitation, 42
 effects of altitude, 42
 perfusion limitation, 42
 oxygen transport
 blood oxygen content equation, 28
 bound to haemoglobin, 28
 dissolved in plasma, 28
 methods of transport in the blood,
 28
 oxygenation
 distinction from ventilation, 104
 oxygenation function
 gas-exchange system, 104
 oxyhaemoglobin, 30
 oxyhaemoglobin dissociation curve,
 30–2
 Bohr effect, 37
 O₂ binding in transfused blood, 32
 oxy-myoglobin dissociation curve, 35
 oxytocin, 391
 pacemaker cells, 254–5
 pacemaker potential, 255
 P_aCO₂ equation, 46
 paediatric anatomy and physiology
 choice of ETT for children, 416–17
 classification of age groups, 416
 differences between children and
 adults, 416–19
 pharmacokinetics in children, 419
 pain
 allodynia, 272
 classification, 269
 complex regional pain syndrome
 (CRPS), 273
 definition, 269
 distinction from nociception, 269
 hyperalgesia, 271–2
 modulation mechanisms, 270–1
 neuropathic pain, 272–3
 nociceptive type, 269
 pain signal pathways to the brain,
 270
 referred pain, 271
 role of the sympathetic nervous
 system, 273
 types of nociceptor nerve fibre,
 269
 pain management
 sympathetic blockade, 267
 pain receptors, 94
 pancreas, 288–90
 paracetamol overdose, 295
 liver function testing, 303
 parasympathetic nervous system,
 184–5, 265–7
 parathyroid gland, 397
 parathyroid hormone (PTH), 396
 parietal lobe of the brain, 186
 Parkinson's disease, 195
 Pasteur point, 81
 patellar reflex, 244–5
 patent ductus arteriosus, 65
 Paul Bert effect, 102
 penicillins, 310, 312, 364
 pentose phosphate pathway (PPP),
 377
 perioperative care
 effects of procedures on the immune
 system, 364–5
 enhanced recovery programme, 382
 methods of reducing the stress
 response, 386
 risks associated with polycythaemia,
 353–4
 perioperative hypothermia, 431–3
 peripheral chemoreceptors, 167–8
 peripheral nerve structure, 185
 peripheral nervous system (PNS),
 184–5
 peripheral oedema, 156
 pethidine, 410
 pH
 definition, 328
 equation, 328
 homeostatic mechanisms, 331–3
 regulation in the body, 2
 relationship to pK_a, 329
 pH of blood
 change with temperature, 334–5
 in hypothermic cardiopulmonary
 bypass, 335
 pharmacokinetics
 differences between children and
 adults, 419
 pharmacology
 effects of ageing, 423–4
 pharyngeal phase of swallowing, 276
 phenobarbitone, 301
 phenotype (trait), 10–11
 phenylephrine, 149, 423
 phenytoin, 195, 301
 phosphodiesterase inhibitors, 339–40
 physiological dead space
 Bohr method of measurement, 49
 physiological fitness assessment
 metabolic equivalents (MET), 379
 pia mater, 188
 pineal gland, 195
 pituitary adenoma, 391
 pituitary gland, 186, 195
 anatomy, 388
 blood supply, 388–9

Index

- pituitary gland (cont.)
hormones released by the posterior lobe, 390–1
hormones secreted by the anterior lobe, 389–90
hypothalamic–pituitary axis, 389
- pK_a , 329
equation, 328–9
- placenta
anatomy related to function, 408–9
development, 408–9
functions, 408
mechanisms for transfer across, 409–10
transfer of drugs across, 410
- placental antibody transfer, 409
- plasma
constituent of blood, 366
hyperkalaemia, 326–7
hypokalaemia, 327
mechanisms to regulate potassium (K^+) concentration, 325–6
- plasma cholinesterase, 20
- plasma glucose concentration
effects of insulin and glucagon, 377–9
- plasma osmolarity
clinical disorders of osmolarity, 320–1
definition of osmolarity, 317
estimated plasma osmolarity equation, 317
feedback loop control, 318
hypotonicity, 318
importance of regulation, 317–18
interaction with plasma volume regulation, 324
- plasma pH
Henderson–Hasselbalch equation, 329
- plasma proteins
classification, 366
functions of albumin, 366–7
- plasma volume
interaction with plasma osmolarity regulation, 324
physiological response to high volume, 324–5
physiological response to low volume, 323–4
regulation, 316–17
- platelets, 338
anti-platelet drugs, 116, 338–40
- pneumectomy, 43–4
- pneumonia, 99
effects on the oxygen cascade, 81
- pneumotachograph, 56
- pneumotaxic centre, 92
- pneumothorax, 25
- polycythaemia, 353–4
- pons, 187
- portal veins, 158
- positive end-expiratory pressure (PEEP), 21–2, 44, 87
extrinsic, 91
influence on venous return, 159
one-lung ventilation, 100
physiological, 90
- positive feedback, 4
- positive pressure ventilation
influence on venous return, 159
one-lung ventilation, 100
- positron emission tomography (PET)
measurement of CBF, 200
- postoperative nausea and vomiting (PONV), 284
- potassium (K^+) in the body, 219, 325–7
- potassium channel openers, 116
- pregnancy, 379
alterations in endocrine function, 401–2
challenges of general anaesthesia, 403
incidence of glycosuria, 312
physiological changes and anaesthesia, 402–6
pre-eclampsia, 408–9
vena cava compression, 159–60
- preoperative fasting, 282–3
- pre-oxygenation for general anaesthesia, 52
- probencid, 312
- prolactin (PRL), 387, 389–90
- propofol, 195, 231, 365, 410
- proprioception, 243
- prosencephalon (forebrain), 187
- prostacyclin (PGI₂), 157
- protein, 374
digestion and absorption, 287–8
- proteinuria, 156
- proton-pump inhibitors (PPIs), 281, 285
- pseudocholinesterase, 20
- pseudounipolar neurons, 184
- pulmonary arteriovenous malformation (AVM), 65
- pulmonary artery catheter (PAC), 73, 100
- pulmonary circulation
calculation of pulmonary vascular resistance (PVR), 96–7
comparison with the systemic circulation, 141
factors affecting PVR, 97–9
PVR compared with SVR, 96–7
reason for normal low pressure, 96
unique features, 96
- pulmonary embolism (PE), 71
- pulmonary fibrosis, 88, 99
related to bleomycin treatment, 103
- pulmonary function tests (PFTs), 56
- pulmonary hypertension, 157
- pulmonary oedema, 96, 156
- pulmonary surfactant, 83–4
- pulmonary vascular resistance (PVR), 96–100
- pyramidal cells, 184
- pyramidal tract, 211–12
- ranitidine, 281
- rapid sequence induction (RSI), 55
- reactive oxygen species (ROS), 102
- red blood cell (RBC) antigens
ABO blood group system, 345
antibody development by the immune system, 345–6
range of antigen systems, 345
Rhesus blood group system, 345
Rhesus disease, 346
- red blood cells (RBCs)
cell membrane antigens, 29
erythropoiesis, 351
stages of erythropoiesis, 29
steps in production, 351
structure and function, 29
- refeeding syndrome, 382
- referred pain, 271
- reflex arcs, 243–4
knee-jerk reflex, 244–5
- remifentanyl, 20
- renal clearance equation, 313
- renin–angiotensin–aldosterone axis, 308–9
- Renshaw cells, 184
- reproductive system, 2
- residual volume (RV) of the lungs, 50
- respiration
regulatory role of cerebrospinal fluid, 191
- respiratory acidosis, 329–30
- respiratory alkalosis, 330
- respiratory centre
effects of opioid drugs, 95
inputs, 92–4
reflex desensitization, 105
role in ventilation control, 92
- respiratory compliance, 82–3
- respiratory compliance equation, 82
- respiratory failure
chronic hypercapnoea in stable COPD patients, 105
definition, 104
exacerbation of COPD, 106
in patient with myasthenia gravis (MG), 105
processes which cause type 2 failure, 104–5

- type 1, 104
- type 2, 104
- respiratory quotient (*R*), 77–8
- respiratory system, 1
 - effects of airway devices, 108
 - effects of anaesthetic drugs, 107–8
 - effects of exercise, 178–9
 - oxygenation function (gas exchange), 104
 - ventilation function (bellows), 104
- respiratory system functional
 - anatomy, 21–4
 - alveoli, 24
 - bronchi, 23
 - bronchioles, 23–4
 - conducting zone, 22–4
 - larynx, 21
 - lungs, 23
 - mucociliary escalator, 22
 - respiratory bronchioles, 24
 - respiratory zone, 24
 - trachea, 22–3
 - tracheobronchial tree, 22–4
 - upper airway, 21
- resting membrane potential (RMP)
 - cardiac muscle cells, 250
 - contribution of Na^+/K^+ -ATPase, 218–19
 - definition, 217
 - effects of electrolyte disturbances, 219–20
 - Goldman–Hodgkin–Katz equation, 218
 - Nernst equation, 218
 - Nernst equation applied to explain RMP, 218
 - production of, 217–18
- restrictive lung disease, 90
- reticulocytes, 29
- retina
 - oxygen toxicity effects, 102
- retinopathy of prematurity, 102
- retrolental fibroplasia, 102
- reverse Fick principle, 74
- Reynolds number, 88–9
- Rhesus blood group system, 29, 345
- Rhesus disease, 346
- rhombencephalon (hindbrain), 187
- rifampicin, 301
- right ventricular pressure-volume loop, 138
- RNA (ribonucleic acid), 8–10

- salbutamol, 327
- saliva, 275–6
- salivary glands, 275–6
- sarcomeres, 236–9
- Schwann cells, 185

- selective serotonin reuptake inhibitors (SSRIs), 232
- semi-permeable membranes, 40
- sensory (afferent) neurons, 183
- sepsis, 121
- septic shock, 149
- serotonin, 387
- shunt equation, 66–8
- shunts, 65–8
- sickle cell disease, 10, 348
 - anaesthesia management, 33
 - effects of a single point Hb mutation, 32–3
 - HbS abnormal haemoglobin, 32
 - operative management issues, 33
 - testing patients for, 33
- sickle cell trait, 32
 - testing patients for, 33
- skeletal muscle
 - anatomy, 236
 - differences from smooth muscle, 247
 - disorders, 242
 - effects of exercise on, 176
 - effects of physical training, 182
 - energy sources, 175
 - excitation–contraction coupling, 239
 - factors which determine muscle tension, 241–2
 - fibre types, 174–5
 - functions, 236
 - malignant hyperthermia, 239–40
 - mechanism of contraction, 240–1
 - motor units, 241
 - muscle fatigue, 175
 - sarcomeres, 236–9
 - Type I (slow-twitch, fatigue-resistant) fibres, 174–5
 - Type II (fast-twitch) fibres, 174–5
- skeletal system, 2
- skin
 - integumentary system, 2
- small intestine, 286–7
 - intestinal motility, 290–1
- smoking
 - effect on hepatic enzymes, 301
- smooth muscle
 - adaptation to its function, 249
 - contraction mechanism, 248–9
 - description, 247
 - differences from skeletal muscle, 247
 - excitation–contraction coupling, 247–8
 - excitatory inputs, 247–8
 - locations in the body, 247
 - types of, 247
- sodium (Na^+) in the body, 219, 322–3
- sodium nitroprusside, 149
- somatostatin, 389
- spinal anaesthesia, 386
- spinal cord, 184
 - anatomy, 207
 - anterior spinal artery syndrome, 209
 - blood supply, 208–9
 - corticospinal tract, 211–12
 - cross-sectional anatomy, 207–8
 - dissociated sensory loss, 210–11
 - main sensory afferent pathways, 209–10
 - meninges, 187–8
- spinal cord injury, 172
 - classification, 212
 - effects related to level of complete injury, 212–13
 - initial management of acute spinal cord injury, 214–16
 - patterns of incomplete spinal cord injury, 214
 - spinal shock, 245–6
- spirometers, 56
- spirometry
 - dynamic spirometry, 56
 - expiratory flow–volume curve, 58–9
 - forced spirometry, 56–7
 - lung variables measured, 56
 - measurement of lung volumes and capacities, 52
 - preoperative work before lung resection, 61–3
 - static lung volume measurements, 56
- spironolactone, 326
- stagnant hypoxia, 64
- staircase effect, 122
- Starling filtration equation, 154
- Starling forces
 - and the glomerular filtration rate (GFR), 313
 - and transmembrane fluid flow, 154–6
- Starling's law of the heart, 120–1, 130
- starvation, 374, 381–3
- static compliance curve, 85–7
- static lung volumes
 - use of spirometer to measure, 56
- steatorrhoea, 288
- Stewart–Fencl–Story approach to acid–base physiology, 335–6
- stomach
 - control of gastric emptying, 281–2
 - functions, 279
 - gastric acid secretion by parietal cells, 280–1
 - gastric dumping syndrome, 282
 - neutralization of gastric acid, 281

Index

- stomach (cont.)
 phases of gastric secretion, 281
 preoperative fasting, 282–3
 substances secreted by, 279–80
 time taken for gastric emptying, 282
See also vomiting
- stress response, 384–6
- stroke
 Bamford classification, 189
 stroke volume (SV), 120, 152
 stroke volume (SV) equation, 119
 stroke volume index (SVI), 122
 subarachnoid space, 188
 subdural space, 188
 subthalamus, 187
 sulphonamide drugs, 301
 superoxide anion ($O_2^{\cdot-}$), 102
 surfactant. *See* pulmonary surfactant
- surgical risk
 and $\dot{V}O_{2\max}$, 180–1
- Surviving Sepsis Campaign guidelines, 163
- suxamethonium, 20, 234–5, 239, 326, 419, 424
- suxamethonium apnoea, 20
- swallowing, 276–7
- Swan–Ganz catheter, 100
- sympathetic blockade, 267
- sympathetic nervous system, 184–5, 265–7, 273
- synapses
 definition, 228
 ionotropic receptors, 229–30
 metabotropic receptors, 232
 neurotransmitter reuptake
 inhibitors, 232
 neurotransmitters, 228–9
 termination of neurotransmission, 232
 types of, 228
See also neuromuscular junction (NMJ).
- synaptic cleft
 release of neurotransmitters, 229
- syndrome of inappropriate ADH secretion, 321
- syringomyelia, 211
- systemic circulation, 141
 changes in blood flow, 142–3
 comparison with the pulmonary circulation, 141
 constituent parts, 141
 functions, 141
See also arterial system; venous system.
- systemic inflammatory response syndrome (SIRS), 357
- systemic lupus erythematosus, 310, 364
- systemic vascular resistance (SVR), 96–7, 120, 147–8, 152
- systolic blood pressure (SBP), 148
- tachycardia
 blood pressure calculation, 148
 Bowditch effect, 122
 effects on cardiac output (CO), 119
- telencephalon (cerebrum), 186
- temperature regulation, 2
 adverse effects of hypothermia, 432–3
 adverse effects of intraoperative hypothermia, 433
 effects of anaesthesia on normal mechanisms, 431–2
 effects of exercise, 179
 mechanisms, 431
 role of the venous system, 158
- temporal lobe of the brain, 186
- testosterone, 387
- tetanus, 361
- thalamus, 94, 186
- thalassaemia, 348
- thalidomide, 410
- thiopentone, 195, 231, 365–6, 410, 419
- thoracic cage compliance, 82
- thromboelastography, 343
- thrombolysis, 343–4
- thrombosis
 risk in polycythaemia, 353
- thymine (T), 8
- thymus, 358
- thyroid gland
 anaesthesia for thyroid surgery, 394–5
 Graves' disease, 394
 hormones synthesized by, 392
 physiological effects of T_3 (triiodothyronine), 392
 regulation of plasma thyroid hormones, 393–4
 synthesis of T_3 and T_4 , 392–3
- thyroid-stimulating hormone (TSH), 387, 389–90
- thyrotropin-releasing hormone (TRH), 387
- thyroxine, 387
- tidal volume (V_T), 50
 in mechanically ventilated patients, 51
- TLCO (lung transfer factor for CO), 43
- tonsillectomy, 22
- total lung capacity (TLC), 50
- trait (phenotype), 10–11
- tranexamic acid, 344
- transcranial Doppler ultrasonography, 200
- transferases, 19
- transfusion-related acute lung injury (TRALI), 348
- transfusion-related immunomodulation (TRIM), 365
- traumatic brain injury (TBI), 204–5
- Treppe effect, 122
- tricarboxylic acid cycle. *See* citric acid cycle
- tuberculosis, 364
- unipolar neurons, 184
- urea
 handling by the kidney, 322
- urinary system, 2
- valproate, 301
- Valsalva manoeuvre, 171–3
- varicella zoster, 361
- vascular endothelium
 role in haemostasis, 337
- vasoactive substances
 synthesis in the endothelium, 157
- vasopressin. *See* antidiuretic hormone (ADH)
- veins, 158
- vena cava
 compression in pregnancy, 159–60
- venous cannulation, 164–5
- venous pressure
 effects on resistance to blood flow, 160
- venous pressure waveforms
 features of the CVP waveform, 161
- venous return to the heart, 158–60
- venous system, 158–60
- ventilation
 alveolar ventilation, 46
 definition of dead-space ventilation, 46
 distinction from oxygenation, 104
 minute ventilation, 46
- ventilation control
 anatomical sites involved, 92
 effects of drugs on, 95
 neuronal feedback loops, 92
 respiratory centre inputs, 92–4
 role of the respiratory centre, 92
- ventilation–perfusion matching, 71
- ventilation–perfusion mismatch, 21, 65–6, 70–1, 109
- ventilation–perfusion ratio, 69–70
- ventilator-associated lung injury, 51

- ventilatory response
 - to hypercapnoea, 94
 - to hypoxaemia, 94
- ventral respiratory group (VRG) of neurons, 92
- ventricular septal defect, 65
- vertebral arteries, 188–9
- vital capacity (VC), 50
- vitalograph, 56
- vitamin D, 396–7
- $\dot{V}O_2$ max
 - and surgical risk, 180–1
 - meaning of, 179–80
- vocal cords, 21
- volatile anaesthetics, 41–2, 149, 195, 239
- voluntary control of breathing, 94
- volutrauma, 51
- vomiting, 283–4
- von Willebrand disease, 341
- von Willebrand factor (vWF), 157
- warfarin, 366–7
- waste products
 - removal from the body, 2
- water
 - distribution in the body, 316
- measurement within body
 - compartments, 316
 - regulation in the body, 2
- Wernicke's area, 186
- West zones of the lung, 72–3
- Willis, circle of, 188–9
- Windkessel effect, 150
- work of breathing, 88–91
- X-linked recessive inheritance, 11–12
- xenon-133 isotope, 200
- xenon anaesthesia, 231–2