

Index

- absolute pressure 166
- absolute velocity 61
- acceleration 42
 - angular 123
 - constant 43–46
 - due to gravity 44–46
 - from velocity-time graph 42, 47–49
 - uniform circular motion 55–56
- accepted values 9
- accuracy 13, 14
- air resistance 44–45, 115, 177
- aircraft
 - airspeed measurement 180
 - lift forces 175, 180
 - turbulence 176
- altitude 169
- analysis 4, 20
- angles, measuring 55
- angular acceleration 123
- angular impulse 136–137
- angular momentum 76, 135
 - law of conservation of 138–139
- angular velocity 55–56, 119
- Archimedes's principle 169–170
- atmospheric pressure 166
- average acceleration 42
- average velocity 41–42
- axis of rotation 119
 - parallel axis theorem 133–134
 - rotational inertia and 125, 133–134
- banked roads 93–94
- Bernoulli's principle 175, 179–180
- black bodies 196–197
- boiling 188, 189, 190–191
- brittle materials 162
- bulk modulus 164
- buoyant forces 169–170
- calculated values 7–8, 15–16
- calorimetry 187
- capillary action 173–174
- carburettors 180
- cars
 - safety features 80
 - streamlining 177
 - uniform circular motion 92, 93–94
- centre of mass 86–88
 - equilibrium and 152
 - of particle systems 140–141
 - of rigid bodies 140–142
- centripetal force 57–58, 95
- changes of state 187, 188
- co-ordinate grids 40, 41
- coefficient of viscosity 181
- collinear vectors 24, 28–30
- collisions 82–84, 113
- commutative law 28
- component vectors 26, 31, 41
- compressibility, effect on fluid flow 176
- compressional deformation 159
- conclusions 4, 20
- concurrent forces 144–145
- conduction 192, 193
- conservation of angular momentum, law of 138–139
- conservation of energy, law of 111–113, 115
- conservation of linear momentum, law of 76–77, 79
 - in collisions 82–84, 113
 - variable mass systems 90–91
- conservative forces 114, 115
- contact angle 172
- convection 194, 197
- conversion factors 15
- cooling, Newton's law of 197
- coplanar forces 146, 151–153
- coplanar vectors 25, 28–30
- couples 155–156
- critical point 187
- crumple zones 80
- deformation 159–161
 - elastic limit 161
 - modulus of elasticity 162–164
- density
 - of the atmosphere 169
 - effect on fluid flow 176
 - pressure and 166
- displacement, from velocity-time graph 47–49
- displacement-time graphs 41, 44, 46–47
- dissipative forces 114, 115
- dot product *see* scalar product
- ductile materials 162
- dynamic equilibrium 151
- dynamic pressure 179, 180
- dynamics, basic laws of 69–73
- elastic behaviour 159–165
- elastic collisions 82, 113
- elastic deformation 159, 161
- elastic limit 159–160, 161
- elastic potential energy 107
- energy 103
 - conservation of 111–113, 115
 - heat *see* heat energy
 - kinetic *see* kinetic energy
 - mechanical 111, 114–115
 - in oscillations 112
 - potential 103–104, 107–109
 - stored in a spring 108–109
 - strain energy 164–165
 - surface energy 171
- equation of continuity 177–178
- equations of motion
 - linear motion 39, 129
 - rotational motion 129, 131
- equilibrium
 - concurrent forces 144–145
 - conditions 151
 - coplanar forces 151–153
 - floating objects 169
 - limiting 72
 - of a particle 144–145
 - rotational 154
- errors 9–12
 - parallax errors 10–11
 - random errors 9–10, 15
 - systematic errors 11–12
 - zero errors 12
- evaporation 189, 192, 197
- experiments 1, 3–4
 - writing up 17–18
- explosions 91
- falling bodies 44–46
- floating objects 169–170
- flow rate 176, 177–178
- fluids
 - Bernoulli's principle 175, 179–180
 - bodies moving in 181–182
 - equation of continuity 177–178
 - flow rate 176, 177–178
 - laminar flow 175, 182
 - measuring flow speed 180

- turbulent flow 175–176, 182
- viscosity of 180–181
- see also* liquids
- force-displacement graphs 102–103
- force-extension graphs 108–109, 161, 162
- forces 67
 - addition 31
 - centripetal 57–58, 95
 - change of momentum and 80
 - concurrent 144–145
 - conservative 114, 115
 - coplanar 146, 151–153
 - in deformation 159–160
 - dissipative 114, 115
 - effect on springs 108–109
 - equilibrium and 144–145
 - moments of 85–86, 146–149
 - resolving 67–68
 - in uniform circular motion 57–59, 92–95, 119
 - viscous drag 180–182
 - work done and 99–103
- frames of reference 40–41, 130
- framework for reports 18–20
- free body diagrams 44–45
- friction 71–73, 104
 - in circular motion 57, 92–94
 - as dissipative force 115
- fusion *see* melting

- Galileo Galilei 46, 73
- gases, collisions in 82
- glancing collisions 83
- global warming 197
- gravitational potential energy 107, 108, 114, 115
- gravity 60, 73
 - acceleration due to 44–46
 - as conservative force 115
 - motion in a vertical circle 57–59
 - work done against 99–100, 106, 107–108
- greenhouse effect 197
- gyroscopes 135, 136

- head-on collisions 83
- heat energy 191–192
 - changes of state and 188
 - radiation of 196–197
 - rate of loss 197
 - thermal conductivity 194–195
 - transfer of 192–194
- Hooke's law 161
- hydraulic brakes 167
- hypothesis 2, 3, 4

- impulse 78–80, 136
- inelastic collisions 82, 113
- instantaneous acceleration 42
- instantaneous velocity 41
- instruments
 - parallax errors 10–11
 - precision 5, 6, 15
 - zero errors 12
- insulation 192, 193, 197

- Kepler's laws 95
- kinetic energy 104
 - in collisions 83, 113
 - during changes of state 187
 - rotational 126–127
 - transfers to potential energy 111–112
 - work and 104–105
- kinetic friction 71, 72–73, 104

- laminar flow 175, 182
- latent heat 188
- limit of proportionality 161
- limiting equilibrium 72
- limiting friction 72
- linear momentum 76, 135
 - law of conservation of 76–77, 79, 82–84, 90–91, 113
 - rate of change of 80
 - variable mass systems 90–91
- liquids
 - capillary action 173–174
 - contact angles 172
 - pressure difference across surface 171
 - surface energy 171
 - surface tension 170–173
 - transmission of pressure in 167–168
 - viscosity 180–181
 - see also* fluids
- measurements 4–7
 - accuracy 13, 14
 - errors in 9–12
 - multiple values 7, 15
 - precision 5, 6, 13, 14
 - significance 13–14
 - significant figures 4–5, 13
 - uncertainties 6–7
 - units 4, 15
- mechanical energy 111, 114–115
- melting 188, 189–190
- meniscus 173
- mistakes 9
- moment of a force 85–86, 146–149
- see also* torque

- moment of inertia *see* rotational inertia
- mousetrap car 106
- multiple values 7, 15

- neutral buoyancy 170
- neutral equilibrium 152
- Newton's cradle 79
- Newton's law of cooling 197
- Newton's law of universal gravitation 60, 73
- Newton's laws of motion
 - demonstrating 70
 - first law 57, 69, 144
 - linear momentum 76
 - second law 70, 71, 76, 90, 104–105
 - third law 70, 76, 90
- orders of magnitude 16

- parallax errors 10–11
- parallel axis theorem 133–134
- parallelogram rule 29
- Pascal's law 167
- peer review 2
- pendulums 58, 112
- percentage uncertainties 7–8
- phase change diagrams 187
- phase changes 187, 188
- phases 187
- planetary motion, Kepler's laws of 95
- plastic deformation 159, 161
- pneumatics 168
- position vectors 24
- potential energy 103–104, 107–109
 - transfers to kinetic energy 111–112
- power 116, 132
- precision 13, 14
 - of instruments 5, 6, 15
 - uncertainty and 6, 13
- predictions 3
- pressure
 - due to a fluid column 166–167
 - dynamic 179, 180
 - static 179, 180
 - transmission in liquid 167–168
- projectile motion 52–54
- Pythagoras's theorem 27, 30

- racetracks 93–94
- radial force 57, 95, 119
- radians 55, 119
- radiation 196–197
- random errors 9–10, 15
- recoil-less rifles 79
- relative velocity 61

- report writing 17–20
- research 3
- results, recording 17–18
- Reynolds number 182
- right-hand rule 35, 121
- rockets 90
- rotation about a fixed axis 119
- rotational equilibrium 154
- rotational inertia 124–126
 - parallel axis theorem 133–134
- rotational kinetic energy 126–127
- rotational motion
 - equations 129, 131
 - frame of reference 130
- rotational stability 169

- sailing craft 180
- satellites, motion of 60
- scalar product 33–34
- scalar projection 34–35
- scalar quantities 23, 33
- scale diagrams 28
- scientific method 1, 2–4
- seat belts 80
- shear deformation 159
- shear modulus 164
- significance 13–14
- significant figures 4–5, 13
- specific heat capacity 184–187
- specific latent heat
 - of fusion 189–190
 - of vaporisation 190–191
- speed 41
- springs
 - conservative forces 115
 - energy stored in 108–109
- stability 87–88, 140
 - floating objects 169
 - rotational 169
- stable equilibrium 152
- static equilibrium 151
- static friction 71–72, 104
- static pressure 179, 180

- Stefan–Boltzman law 196–197
- Stokes’s law 181–182
- strain energy 164–165
- streamline flow 175, 182
- streamlining 177
- submarines 169–170
- surface energy 171
- surface tension 170–173
- systematic errors 11–12

- tangential force 95
- temperature 191–192
 - changes of state and 187
 - cooling and 197
 - effect on fluid flow 176
- tensile deformation 159, 160
- tensile strain 161
- tensile stress 160
- terminal velocity 46, 182
- thermal conductivity 194–195
- thermal energy *see* heat energy
- thermal expansion 194
- torque 85–86, 120–123, 136, 146, 147
 - of a couple 155–156
 - in rotational equilibrium 154
 - work done by 122, 132
- torsional deformation 159
- triangle rule 29–30
- triple point 187
- true values 9, 13
- turbulent flow 175–176, 182

- uncertainties 6–7, 13
 - calculating 7–8
 - from instruments 15
 - percentage uncertainties 7–8
- uniform circular motion 55–57
 - forces acting 57–59, 92–95, 119
 - in a horizontal circle 57, 92–94
 - in a vertical circle 57–59, 95
- unit vectors 24, 35, 121
- units 4, 15
- unstable equilibrium 152

- vaporisation *see* boiling; evaporation
- vector product 35–36, 121
- vectors 23
 - addition and subtraction 28–31
 - applications 36
 - multiplication 33–36
 - representing 23
 - resolving 26
 - scalar product 33–34
 - scalar projection 34–35
 - types 24–25
 - vector product 35–36, 121
- velocity 41–42
 - absolute 61
 - angular 55–56, 119
 - constant acceleration and 43–46
 - from displacement–time graph 41, 44, 46–47
 - motion in a vertical circle 57–59
 - relative 61
 - terminal 46, 182
 - velocity–time graphs 42, 47–49
- viscosity 180–181
- viscous drag force 180–182

- weightlessness 74
- work 99, 101
 - against gravity 99–100, 106, 107–108
 - done by constant forces 99–102, 103
 - done by a torque 122, 132
 - done by variable forces 102–103
 - extension of a spring 108
 - kinetic energy and 104–105
 - work–energy theorem 104–106

- yield point 161
- Young modulus 162–163
- Young–Laplace equation 171

- zero errors 12

