
Index

- acceleration, xiii, 2, 3, 11, 55, 61,
71, 72, 76, 79, 87, 92
- angular, 84, 85, 87
- angular, and curl, 91
- centripetal, 51
- gravitational, 125, 129, 175
- seen geometrically, 14
- tangential, 85
- adjoint, 239, 244, 247, 253
- analogy, xvi
- Bernoulli's optical, 192
- between functionals and
 functions on \mathbb{R}^n , 21
- between mechanics and optics,
 280, 283
- between rotational and
 translational motions, 87
- between wave optics and
 quantum mechanics, 284
- kinetic, Kirchhoff's, xvi
- static, of Hamiltonian dynamics,
274
- static, with Hamiltonian
dynamics, 280
- used to minimize a functional,
187
- with uncertainty principle, 37
- angular momentum, 148
- evolution of, in the body frame,
 152
- angular momentum, 80, 87, 98,
 128, 131
- conservation of, 81, 82, 93, 269
- conservation of, and Kepler's law
 of areas, 94
- conservation of, interpreted as
 torque balance, 269, 280
- of a comet, 80
- of a gymnast, 83
- of a rigid body, 144, 150
- of a system of particles, 80
- of a tennis racket, 151
- of precessing wheel, 157
- angular velocity, 55, 56, 63, 84, 86,
87, 101, 131
- determining the pendulum's
 height, 136
- in the phase plane, 219
- of a rigid body, 144, 150
- of precession, 156
- of spring-masses in space, 166
- of the universe, 150
- bead on a surface, 180
- bead on a wire, 3, 4, 7, 9, 51, 52,
55, 59, 183, 193, 255
- bike, 56
- wheel, 157, 158, 160
- brachistochrone, 183, 189–191, 193
- Bernoulli's solution, 192, 193

- catenary, 54, 183, 200, 201, 203, 204
 an elementary solution, 204
- center of mass, 63, 76–79, 83, 84, 86, 126, 127, 129, 133, 152, 153, 157, 165, 168
- central force field, 92, 93, 96, 128
- centrifugal force, 76, 98, 119–121, 133, 154, 155
- Chaplygin's sleigh, 106, 107, 168
- Chebyshev's polynomials, 111–113
- conic sections, 95–98, 102, 130
- conjugate point, 177, 178, 198, 199, 212–214, 217, 224, 259
 a mechanical interpretation of, 228
- conservative force fields, 88–90, 93, 179
 and fluids, 91
- Coriolis force, 76, 98, 119–121, 133
- curl, 90, 91
- cycloid, 4–6, 51, 55, 59, 190–192
- distribution of planes, 107
- divergence, 26, 28–31, 34–36, 71, 137, 257
- ellipsoid of inertia, 148, 152, 153
- energy conservation, 11–13, 16, 23, 71, 91, 114, 175, 190, 270, 271, 276, 280
- equivalence
 mechanical-electrical, 51
- equivalence between dynamics and statics, 45
- evolute, 6, 55, 56
- Fermat's principle, 237
- Fermat's principle, xix, 13, 174, 192, 193, 195, 196, 206
- Feynman, xix, 173, 177, 284
- generating function, 208, 273, 276, 280
- geodesics, 170, 194–196
- gradient, 25, 60, 118, 135, 163, 169, 172, 177, 206, 259, 260, 267, 272, 278
- gyrocompass, 142, 154, 159–161
- gyroscopic effect, 154, 155
- Hamilton's principle, xix, 20, 167, 171–174, 178, 179, 183, 258, 259
- Hamilton–Jacobi equation, 258, 266, 267, 274, 283
- Huygens's principle, xv, xvii, 237, 250–252, 283, 291, 292
- indicatrix, 251, 291–293
- inertial frame, xviii, 75, 76, 80, 81, 103, 133
- Kepler's problem, xvii, 1, 94, 95
- kinetic energy, 10, 45, 60, 68, 85–87, 91
 of a general mechanical system, 135
 of the rigid body, 147–149
- Lagrange multipliers, 118, 201, 202, 206
- Legendre condition, 211, 215–217, 220, 222, 223, 227, 231, 258, 259, 282
- Liouville's theorem, xv, 26–28, 35, 36, 38, 45, 46, 49, 72, 257, 258, 272, 278
- Lissajous figures, 111
- Maupertuis' principle, xix, 170, 174–176, 178, 179
- Maximum principle of optimal control, xv, xvii, 233, 235–239, 244–246, 252, 254
- moment of inertia, 84, 85, 127
- Noether's theorem, 267–270, 272, 275, 277, 290, 291
- normal modes of vibration, 110, 115, 289
- paradox
 with a chain, 66
 with a gymnast, 83
 with a tennis racket, 141, 151, 152
 with centrifugal force, 133
 with gravity, 122

-
- Poincaré integral invariants, xv,
173, 207, 257, 271, 272, 275,
277–279, 289, 290
- Poinsot's description of rigid body
motion, 141, 152, 153
- potential energy, 6–9, 43, 45–47,
63, 68, 74, 88–90, 119, 126,
127, 168, 201, 228
- as analog of action, 259, 274,
276, 280
- of stretching, 43, 45
- of surface tension, 199
- principal axes of inertia, 146, 147,
150–152, 161
- Rayleigh's quotient, 117, 118, 218
- reachable set, 237, 238, 254
- Schrödinger equation, the, xx, 173,
258, 284, 286
- Snell's law, 192, 193, 206, 207
- soap film, 184, 196–199
- tautochrone, 55, 59
- tensor of inertia, 143, 144, 146, 161
- torque, 80–82, 87, 154–157, 280
and Clairault integral, 208
- uncertainty principle, classical
analog of, 36–38, 289
- vibrations, 57, 64, 104
modal decomposition, 108