# **Selection of mathematics from Wikipedia**

# Mathematics

# Miscellaneous

Elementary mathematics Fixed-point theorem Foundations of mathematics Hilbert's problems List of incomplete proofs List of unsolved problems Mathematical beauty Mathematical constant Mathematics

### **Branches**

\_Areas of mathematics \_Outline of mathematics Algebra Analysis Computational science **Computer science** Discrete mathematics Geometry History of mathematics Logic Mathematical logic Number theory Numerical analysis Probability theory **Statistics** Topology

### **Elementary mathematics**

Analytic geometry Angle Arithmetic Circle Complex number Coordinate system Divisor Elementary mathematics Equation **Euclidean geometry Euclidean vector** Exponentiation Formula Function Functional Functional equation Inequality Integer Irrational number Linear function Logarithm Measurement Negative number Nth root Number Polynomial Positional notation Prime number Quadratic equation Quadratic function **Rational number** Real number System of linear eqs. Triangle Trigonometry Vector

### **Discrete mathematics**

Discrete mathematics Average **Binary** relation **Binomial coefficient Binomial theorem** Combination Combinatorics **Complex network** Congruence relation **Continued fraction** Cryptography Diophantine equation Equivalence relation Euclidean algorithm Factorial **Finite difference** Generating function Graph Graph coloring Graph theory Knot theory Linear difference eq. Logistic map Mathematical induction Modular arithmetic Network science Partially ordered set Partition Permutation **Polynomial GCD** Product Public key cryptography Ramsey theory Ramsey's theorem **Recurrence relation Repeating decimal** RSA Sequence Summation

### **Foundations**

### Philosophy

Anti-realism Constructive proof Constructivism Definitions of mathematics Finitism Formalism Foundations of math Intuitionism Language of mathematics Logicism Philosophical realism Philosophy of mathematics Structuralism

### Set theory

\_List of set theory topics Arithmetical hierarchy Axiom of choice Cantor's diagonal argument Cantor's theorem Class Constructible universe Dedekind-infinite set Determinacy Empty set Forcing Grothendieck universe Impl. of math in set theory List independencies of ZFC Naive set theory **Recursive set** Russell's paradox Schröder-Bernstein thm Set theory Transfinite induction Uncountable set Universe Venn diagram Von Neumann universe Von N.B.G. set theory Well-founded relation Well-order Well-ordering theorem Zermelo set theory ZF set theory Zorn's lemma

# **Foundations**

Logic Logic

Axiomatic system Boolean algebra Compactness theorem Completeness Consistency Decidability Equiconsistency **First-order logic** Formal grammar Formal language Formal system Fuzzy logic Gödel's completeness th. G.'s incompleteness ths. Gödel's speed-up theorem Gödel numbering Hilbert's program Hilbert system Interpretation List of first-order theories List of rules of Logic Logical connective Logical consequence Löwenheim-Skolem thm Mathematical logic Metalogic Model theory Non-standard model Original proof of Gödel no1 Paris–Harrington theorem Peano axioms Primitive recursive arithm. Proof sketch for Gödel no2 Proof theory Propositional calculus Propositional formula Quantifier **Reverse mathematics** Satisfiability Second-order arithmetic Second-order logic Semantics Sequent calculus Skolem's paradox Soundness Structure Syntax Tarski's undef. theorem Theorem Theory Well-formed formula

# Foundations

# Miscellaneous

Algorithm Algorithm random sequence Algorithmic info. theory Automata theory Busy beaver Cellular automaton Chaitin's constant Chomsky hierarchy Church–Turing thesis Computability Computability theory Computable function Computable number **Computational science Computer science Decision problem** Definable real number Entscheidungsproblem Finite-state machine General recursive function Halting problem Hypercomputation Kolmogorov complexity Lambda calculus Lambda calculus definition List undecidable problems Oracle machine Post's theorem Primitive recursive function Quantum complexity theory Quantum computing Quantum Turing machine **Recursion generally Recursion in computing** Recursively enumerable set Theory of computation Transition system Turing's proof Turing completeness **Turing degree Turing machine** Undecidable problem Universal Turing machine

# Computation

**Complexity class** Comp. complexity Complexity of math. ops. Complexity theory **EXPTIME** NP **NP-completeness** Ρ P vs. NP problem Polynomial hierarchy **PSPACE** 

# **Foundations**

# **Transfinite numbers**

Absolute Infinite Aleph number Beth number Burali-Forti paradox Cantor's paradox Cardinality Cardinality of continuum Cardinal assignment Cardinal number Continuum hypothesis **Epsilon numbers** First uncountable ordinal Hartogs number Inaccessible cardinal Indescribable cardinal Large cardinal Large countable ordinal Limit cardinal Limit ordinal List of large cardinals Mahlo cardinal Order type Ordinal analysis Ordinal arithmetic Ordinal collapsing function Ordinal notation Ordinal number Successor cardinal Successor ordinal Transfinite induction Transfinite number Veblen function Von N. cardinal assignment

## Large numbers

Ackermann function Conway chained arrow Fast-growing hierarchy **Fixed-point lemma** Goodstein's theorem Googolplex Graham's number Hyperoperation Knuth's up-arrow notation Kruskal's tree theorem Large numbers Rayo's number Tetration

# <u>Algebra</u>

Miscellaneous Abstract algebra Algebra over a field Algebra Algebraic equation Alebraic structure Associative algebra **Bilinear** map Category theory Category **Clifford algebras** Clifford algebra Commutative algebra Constructible number Functor Hilbert's Nullstellensatz Homological algebra Homomorphism Isomorphism Kernel Module Non-associative algebra **Relation algebra** Space Universal algebra Universal property Variety

**Representation theory** Adjoint representation Cartan decomposition Clebsch-Gordan coeff. Fundamental represent. Group representation Irreducible representation Lie algebra representation Projective representation Representation of Lie group **Representation theory** Repr. of semisimple Lie alg. Representation of SU(2) Repr. of the Lorentz group Repr. of the Poincaré group Spin representation Theorem of highest weight Unitary representation Wigner-Eckart theorem Young tableau

# <u>Algebra</u>

Group theory List of group theory topics Abelian group Alternating group Automorphism group Cayley graph Cayley's theorem Center Classical group Classification finite groups Commutator subgroup Commutator Composition series Conjugacy class Cycle graph Cyclic group Dihedral group Finite group Finitely generated ab. group Free group Generating set of a group Group action Group cohomology Group theory Group History of group theory Klein four-group Lagrange's theorem Lattice of subgroups Linear algebraic group Linear group List of finite simple groups List of named matrices List of small groups Monster group Normal subgroup Permutation group Presentation of a group Quotient group Rubik's cube group Semidirect product Simple group Solvable group Sporadic group Subgroup Subgroup series Sylow theorems Symmetric group Symmetry Tensor product of repr. Weight

# <u>Algebra</u> Continuous groups

\_List of Lie group topics Table of Lie groups 3D rotation group Axis-angle representation **BCH** formula Casimir element Compact group Conformal group Dynkin diagram E8 lattice **Euclidean group** G2 Galilean transformation **Gell-Mann matrices** General linear group **Killing form** Lie algebra Lie group Lie group vs.-Lie algebra Lie theory Lorentz group Modular group Orthogonal group Poincaré group Projective linear group Root system Semisimple Lie algebra Simple Lie group SL2(R) Special linear group Special unitary group Spin group Structure constants Symplectic group Topological group

Unitary group

# <u>Algebra</u> Rings and Fields

\_Glossary of ring theory Glossary of field theory Algebraic closure Algebraic number field Algebraically closed field Commutative ring **Complex number** Degree of a field extension **Division ring** Euclidean domain Field **Field extension** Finite field Ideal Integral domain Isomorphism theorems Noetherian rings Noncommutative rings Octonion Ordered field Ordered ring **Polynomial ring** Prime ideal Principal ideal domain Quaternion Quotient ring Ring **Ring theory** Splitting field Unique factor domain

# <u>Algebra</u>

#### **Polynomials**

\_List of polynomial topics Algebraic geometry Algebraic number Algebraic variety Bézout's theorem **Binomial theorem** Complete polynomials Cramer's theorem **Cubic equation** Cyclotomic polynomials Discriminant **Eisenstein's criterion** Elem. symmetric polynomial Factorization of polynomials Formal power series Fundamental thm of algebra Gröbner basis Homogeneous polynomial Irreducible polynomial Lagrange polynomial Multinomial theorem Newton polynomial Newton's identities **Polynomial GCD** Polynomial long division Polynomial Quadratic form Resultant Symmetric polynomial Transcendental number Vieta's formulas

## <u>Algebra</u>

#### Linear algebra (A-K)

\_List of linear algebra topics Active passive transform. Affine space Banach space Basis **Bilinear form Block matrix Bra-Ket notation** Cayley Hamilton theorem Change of basis Characteristic polynomial Cokernel Coordinate vector Co- and contravariance Cramer's rule Cross product Determinant Diagonalizable matrix Dot product Dual space Eigendecomp. of a matrix Eigenvalues and eigenvect. **Euclidean space** Gamma matrices Gaussian elimination Gramian matrix Hermitian adjoint Hermitian matrix Hilbert space Inner product space Invertible matrix Jordan matrix Jordan normal form Kernel Kronecker product

# <u>Algebra</u> Linear algebra (L-Z)

Linear algebra Linear form Linear map Linear programming Linear subspace Matrix decomposition Matrix multiplication Matrix Minor Norm Normed vector space Orientation Orthogonal matrix Pauli matrices Polar decomposition Pseudo Euclidean space Quadratic form Quaternions and rotation Rank Rank-nullity theorem Riesz repr. theorem **Rigid transformation** Rotation formalisms in 3D Rotation matrix Self-adjoint operator Singular v. decomposition Spectral theorem Spinor Square matrix Sylvester's law of inertia Symplectic matrix Symplectic vector space System of linear equations Trace Transformation matrix Unitary matrix Vandermonde matrix Vector space

# <u>Algebra</u>

Multilinear algebra Bivector

Cartesian tensor **Einstein notation** Exterior algebra Geometric algebra Hodge star operator Levi-Civita symbol Metric tensor Mixed tensor Multilinear algebra Multilinear form Multilinear map Multivector **Ricci calculus** Symmetric algebra **Tensor** algebra Tensor contraction Tensor intrinsic definition Tensor Tensor product

#### Order, Lattice, Boolean

Boolean algebra Boolean ring Complete lattice Distributive lattice Join and meet Lattice Leech lattice Lexicographic order Order theory Partially ordered set Total order

# Galois theory

Abel-Ruffini theorem Fundamental thm of Galois Galois extension Galois group Galois theory Resolvent

# <u>Analysis</u>

**Continuity and Limits** 

Absolute continuity Absolute convergence Analysis Big O notation Cantor function Cauchy sequence Change of variables Construction of the reals Continuous function E

 $(\varepsilon, \delta)$ -definition of limit History of calculus Infimum and supremum Limit of a function Lipschitz continuity List of limits Minkowski's ?(x) Sequence Uniform continuity Uniform convergence

### Topology

Glossary of topology Base Borel set Compact space Connected space Filters in topology General topology Hausdorff space Manifold Separable space Separation axiom Topological space

# <u>Analysis</u>

Derivation Closed and exact diff. forms Covariant derivative Derivative Differential calculus Differential form Diff. forms on a R. surface Differential of a function Differentiation rules Directional derivative Exterior derivative Functional derivative Partial derivative Smoothness Total derivative

### Integration

Antiderivative Contour integration **Elliptic integral** Functional integration Fundament thm of calculus Integral Integration by parts Integration by substitution Lebesgue integration Lebesgue measure Leibniz integral rule Line integral Mean value theorem Measure Null set **Riemann integral** Sigma-algebra

<u>Analysis</u> Real & Serial expansion

\_List of real analysis topics Algebraic curve Analytic function Calculus Calculus of variations Change of variables Converg. of Fourier series Convergence tests Convolution Critical point Curvilinear coordinates Dirac delta function Distribution Fixed point Fourier analysis Fourier inversion theorem Fourier series Fourier transform Fundamental solution Generating function Lagrange multiplier Laplace transform List of math functions Matrix calculus Matrix exponential Matrix function Parametric equation Polar coordinate system Power series Series Spherical coordinate system Taylor's theorem Taylor series

# <u>Analysis</u>

**Multivariables & Vectors** List multiv. calculus topics Conservative vector field Curl Divergence Divergence theorem **Exact differential** Exterior calculus identities Flux Function of several variables Gradient Gradient theorem Green's theorem Helmholtz decomposition Hessian matrix Inexact differential Jacobian matrix and determ. Multiple integral Multivariable calculus Stokes' theorem Surface integral Tensor calculus Tensor field Vector calculus Vector calculus identities Vector field Volume element

### **Functional analysis**

Glossary functional analysis Arzelà–Ascoli theorem Banach fixed-point theorem Banach space Borsuk-Ulam theorem Compact operator Complete metric space Functional analysis Functional determinant Function space Hahn–Banach theorem Hilbert space Lp space Metric space

### <u>Analysis</u>

#### **Differential equations** Attractor

**Bessel function** Boundary value problem Characteristic equation **Differential equation** Differential operator **Elliptic PDE** Euler–Lagrange equation Exact differential equation Frobenius theorem Functional diff. equation Gamma function Green's function Harmonic function Heat equation Hyperbolic PDE Initial value problem Integral transform Laplace's equation Linear differential equation List of differential equations Lyapunov stability Matrix differential equation **Nonlinear PDE** Ordinary diff. equation **Parabolic PDE** Partial differential equation Picard–Lindelöf theorem **Poisson's equation** Separation of variables Spherical harmonics State-space representation Sturm–Liouville theory Wave equation

# <u>Analysis</u>

### **Dynamical systems**

Conservative system Dissipative system Dynamical system Ergodicity Ergodic theory Integrable system Lotka–Volterra equations Lyapunov dimension Lyapunov exponent Measure preserv. dyn. syst. Mixing Phase space Poincaré recur. Theorem

### Non-linear systems

Baker's map **Bifurcation diagram Butterfly effect** Catastrophe theory Chaos theory Chaotic mixing Feigenbaum constants Fractal Fractal curve Hausdorff dimension Hopf bifurcation Horseshoe map Hénon map Julia set List of fractals Lorenz system Mandelbrot set Nonlinear system Poincaré map **Recurrence plot** Self-similarity Universality

### **Analysis**

#### **Complex analysis**

\_List of complex an. topics Analyticity of holom. func. Analytic continuation Cauchy's integral formula Cauchy's integral theorem Cauchy–Riemann equations Complex analysis Conformal map **Contour integration Elliptic function** Formal power series Geometric function theory Holomorphic function Laurent series Liouville's theorem Monodromy theorem Möbius transformation **Picard theorem** Residue **Residue theorem** Riemann mapping theorem **Riemann sphere Riemann surface** Riemann zeta function Zeros and Poles

# <u>Geometry</u>

Miscellaneous \_List of geometry topics Analytic geometry Curve Differentiable manifold **Differential structure** Elliptic geometry Erlangen program Gallery of curves Geometry Grassmannian Hyperbolic geometry Hyperbolic space Klein geometry Manifold Noncommutative geometry Space Surface Symplectic manifold Symplectic vector space

### Algebraic geometry

Abelian variety Affine variety Algebraic curve Algebraic geometry Algebraic variety Elliptic curve Hilbert's nullstellensatz Moduli space Scheme Zariski topology

# **Euclidean geometry**

Constructible number Constructible polygon Euclidean geometry Euler line Pi Straightedge and compass Triangle

# Projective geometry

Affine geometry Homogeneous coordinates Projective geometry Projective space

# <u>Geometry</u>

## **Discrete geometry**

24-cell Aperiodic tiling Archimedean solid Bravais lattice Convex polytope Coxeter group Coxeter notation Coxeter–Dynkin diagram Cube Discrete geometry E8 lattice Honeycomb **Kissing number** Klein bottle Lattice Leech lattice List of Eucl. uniform tilings List of planar sym. groups List of regular polytopes Möbius strip **Orbifold notation** Penrose tiling Platonic solid Point group Point groups 3 dimensions Polyhedron Polytope Polytope families Pyramid **Regular polytope** Schläfli symbol Schoenflies notation Simplex Space group Sphere packing Symmetry group Tessellation Tesseract Tetrahedron Truncated icosahedron Uniform polyhedron Uniform tiling Wallpaper group

# <u>Geometry</u> Differential geometry

\_List of diff. geometry topics Atlas Covariant derivative Curvature Diffeomorphism Differentiable curve Differential geometry Diff. geometry of surfaces First fundamental form Frenet–Serret formulas Gauge theory Gaussian curvature Gauss map Gauss-Bonnet theorem Gauss-Codazzi equations Geodesic Jacobi field Lie bracket of vector fields Lie derivative Minimal surface Moving frame Principal curvature Pullback Pushforward Radius of curvature Second fundamental form Smooth structure Spinor Spin structure Tensor field Theorema Egregium Torsion of a curve

# <u>Geometry</u>

### **Tangents & Connections**

Affine connection Cartan connection Connection **Connection form** Cotangent space Fiber bundle Frame bundle let Jet bundle Levi-Civita connection Parallel transport Principal bundle Section Tangent bundle Tangent space Vector bundle

### **Riemannian geometry**

Christoffel symbols Curvature form Curvature Killing vector field Formulas Nash embedding theorem Non-Euclidean geometry Pseudo-Riemannian Ricci curvature **Ricci decomposition Ricci flow** Riemannian geometry **Riemannian manifold** Riemann curvature tensor Scalar curvature Tetrad formalism Torsion tensor Weyl tensor

## **Complex geometry**

Calabi–Yau manifold Complex geometry Complex manifold Complex projective space Enriques–Kodaira classes K3 surface Kähler manifold

### **Geometry**

Topology 3-manifold 3-sphere 4-manifold Atiyah–Singer ind. Theorem Brouwer fixed-point thm. Connected sum **Differential topology** Exotic sphere Fibration Genus Geometric topology Hairy ball theorem Hopf fibration Jordan curve theorem Low-dimensional topology Morse theory Orbifold Orientability Poincaré conjecture Poincaré–Hopf theorem Riemann–Roch theorem Surface **Topological manifold** Topology Triangulation

### Knots, Links and Braids

Braid group Jones polynomial Knot Knot invariant Knot polynomial Knot theory Linking number Link List of prime knots

### <u>Geometry</u>

Algebraic topology Algebraic topology Betti number Cellular homology Chain Chain complex Characteristic class Chern class Ch.–Gauss–Bonnet theorem Cohomology Covering space CW complex De Rham cohomology Euler characteristic **Fundamental group** Fundamental polygon Hodge theory Homology Homology sphere Homotopy Homotopy group Homotopy grps of spheres Mayer–Vietoris sequence Poincaré duality Seifert - van Kampen thm Simplicial complex Simplicial homology Singular homology Universal coefficient thm

### Number theory (A-H)

ABC conjecture Additive function Algebraic number field Algebraic number theory Analytic number theory Arithmetic function Arithmetic geometry Artin's conjecture on roots Cauchy functional equation Chinese remainder theorem Class number formula Cyclic number Cyclotomic field Cyclotomic polynomial Diophantine approximation Diophantine equation **Diophantine geometry** Dirichlet's theorem Dirichlet character **Dirichlet L-function Dirichlet** series **Divisor function** Euclid's theorem Euler's theorem Euler's totient function Euler product Faltings's theorem Fermat's Last Theorem Fermat's little theorem Fermat number Fibonacci number Full reptend prime Gaussian integer Gelfond–Schneider theorem Generalized Riemann hyp. Glossary numeric geometry Goldbach's conjecture Hasse principle

#### Number theory (I-Z)

Ideal class group L-function Langlands program Lindeman–Weierstrass thm Liouville number List of numbers List of number theory topics List of recr. number topics Logarithmic integral fnc. Modularity theorem Multiplicative function Möbius function Möbius inversion formula Number Number theory P-adic number Pell's equation Perfect number Prime-counting function Prime gap Prime number Prime number theorem Primitive root modulo n Proof of the Euler formula Quadratic reciprocity Quadratic residue **Rational point Repeating decimal** Riemann hypothesis Skewes's number Splitting of prime ideals Surreal number Transcendental number Transcendent number th. Weil conjectures Wiles's proof of Fermat

# Probability and Statistics (A-E)

**Miscellaneous (A-L)** \_Catalog of articles \_Outline of probability Outline of statistics Algebra of random variables Bayes' theorem **Bayesian network** Bayesian probability **Bayesian statistics** Bertrand's box paradox Birthday problem Central limit theorem Central moment Characteristic function Conditional probability Conditioning Correlation and dependence Covariance Covariance matrix Cox's theorem Cumulative distribution function De Moivre–Laplace theorem Expected value **Fisher information** Joint probability distribution Kurtosis Langevin equation Law of large numbers

### Distributions

\_List of probability distributions Bernoulli distribution Cauchy distribution Chi-square distribution Dirichlet distribution Exponential distribution Gamma distribution Multinomial distribution Pareto distribution Poisson distribution Student's t-distribution Zipf's law

### **Probability and Statistics (F-Z)**

# Miscellaneous (M-Z)

Markov chain Markov kernel Maximum likelihood estimation Measure Measure space Moment Monte Carlo method Monty Hall problem Multivariate normal distribution Multivariate random variable Mutual information Normal distribution Notation in probability and statistics Partition function Poisson point process Power law Probability-generating function Probability Probability axioms Probability density function Probability distribution Probability mass function Probability measure **Probability space Probability theory** Randomness Randomness tests Random number generation Random variable Random walk Relationships among distributions Sample space Sigma-algebra Skewness Standardized moment Standard deviation Statistics Stochastic differential equation Stochastic matrix Stochastic process Three Prisoners problem Variance Wiener process

# Selection of physics from Wikipedia

## **Physics**

#### Branches

\_Outline of physics Astronomy Atomic physics Classical mechanics Classical physics Condensed matter physics Electromagnetism **Experimental physics** General relativity Geophysics Mathematical physics Mechanics Meteorology Modern physics Nuclear physics Optics Particle physics Physics Quantum field theory Quantum mechanics Special relativity Statistical mechanics Theoretical physics Thermodynamics Units 2019 Redefinition of SI units Buckingham  $\pi$  theorem

**Dimensional analysis Dimensionless quantity** International system of units Natural units Rayleigh dimensional analysis Planck units SI base units Miscellaneous Anthropic principle Background independence Dimensionless phys. constant False vacuum Glossary of physics Group contraction History of physics List of com. physics notation List of paradoxes List of unsolved problems Matter **Multiverse** Philosophy of science Philosophy of space and time **Physical constant** Pink noise Scale invariance Scientific law Superth. stochastic dynamics Symmetry Topological defect Vacuum White noise

# **Classical mechanics (A-J)**

Acceleration Action-angle coordinates Action Analytical mechanics Angular displacement Angular momentum Applied mechanics Canonical coordinates Celestial mechanics Centrifugal force Centripetal force Circular motion Conservation of energy Coriolis force Couple D'Alembert's principle Damping ratio Dirac bracket **Dispersion relation** Displacement **Dynamics** Energy Equations of motion Euler angles Euler's laws of motion **Fictitious forces** Field Force Frame of reference Generalized coordinates Hamiltonian constraint Hamiltonian mechanics Hamiltonian system Hamilton-Jacobi equation Harmonic oscillator Impulse Inertial frame of references

### **Field theory**

Classical field theory Field Hamiltonian field History of field theory Lagrangian Lgrangian system Normal mode Standing wave String vibration Wave

# Classical mechanics (K-Z)

**Kinematics Kinetic energy** Lagrangian mechanics Linear motion Mass Mechanics planar motion Moment of inertia Momentum Newton's law of gravitation Newton's laws of motion Noether's theorem Non-holonomic system Non-inertial ref. frame Pendulum Poisson bracket Potential energy Power Principle of least action **Relative velocity Representation of Gal. grp** Rigid body dynamics **Rotating reference frame** Simple harmonic motion Space Speed Statics Time Torque Velocity Vibration Virial theorem Virtual work Work

# Continuum mechanics

Continuum mechanics

### **Fluid mechanics**

Bernoulli's principle Buoyancy Compressibility Derivation of N-S eqns. Drag coefficient Eddy **Euler** equations Fluid dynamics Fluid mechanics **Hvdrostatics** Navier–Stokes equations Newtonian fluid Non-Newtonian fluid **Reynolds** number Rheology Surface tension Turbulence Viscoelasticity Viscosity Vortex

### Solid mechanics

Cauchy stress tensor Deformation Elasticity Elastic modulus Finite strain theory Hooke's law Infinitesimal strain theory Linear elasticity Plasticity Solid mechanics Stress

### Electromagnetism (A-E)

Alternating current Ampère's circuital law Biot–Savart law Capacitance Capacitor Classical electromagnetism Coulomb's law Covariant formulation EM **Current density** Eddy current Electrical element Electrical impedance Electrical network El. resistance and conduct. Electricity Electric charge Electric current Electric dipole moment **Electric field** Electric potential Electric potential energy Electromagnetic field **EM** four-potential Electromagnetic induction Electromagnetic radiation EM stress–energy tensor Electromagnetic tensor Electromagnetism Electromotive force Electrostatics Elementary charge

### Electromagnetism (F-Z)

Faraday's law of induction Four-current Gauss's law Gauss's law for magnetism History of EM theory Inductance Inductor Joule heating Kirchhoff's circuit laws Lenz's law List of EM equations Lorentz force Magnetic field Magnetic moment Magnetic monopole Magnetic vector potential Magnetism Magnetization Math. description EM field Maxwell's equations Maxwell stress tensor Network analysis of circuits Ohm's law Permeability Permittivity Polarization density Poynting vector Resistor Series and parallel circuits SI electromagnetism units Static electricity Voltage

#### **Optics and Light**

Color Diffraction Dispersion Fermat's principle Fresnel equations Geometrical optics History of optics Huygens-Fresnel principle Infrared Lens Light Microwave Optics Photometry Physical optics Polarization Radio wave Radiometry Reflection Refraction **Refractive index** Snell's law Total internal reflection Ultraviolet Wave interference

### **Special relativity**

Derivation Lorentz transf. Four-momentum Four-vector Four-velocity Invariant mass Ladder paradox Length contraction Light cone Lorentz covariance Lorentz transformation Mass in special relativity Mass–Energy equivalence Metric signature Minkowski space Poincaré group Principle of relativity Proper time Rapidity Rel. angular momentum **Relativistic mechanics** Spacetime Spacetime diagram Special relativity Speed of light Tests of special relativity Time dilation Twin paradox World line

## <u>General relativity</u>

Anti-de Sitter space Black hole Cauchy surface Causal structure Christoffel symbols Cosmic censor hypothesis Cosmological constant **Deriving Schw. solution** De Sitter space Einstein field equations Einstein–Hilbert action Equivalence principle Event horizon Exact solutions in GR Frame fields in GR Frame-dragging **FLRW** metric General covariance General relativity Geodesics in GR Gravitational singularity Gravitational wave Hole argument Intro. to mathematics of GR Kerr metric Kerr Newman metric Levi-Civita connection Mass in general relativity Mathematics of GR Maxwell's eqns in curved ST Paradox charge and gravity Penrose diagram Penrose–Hawking sing. thm. Pseudoriemann. manifold **Ricci decomposition** Riemann curvature tensor **Rindler coordinates** Schwarzschild geodesics Schwarzschild metric Stress-energy tensor Tests of general relativity Tetrad formalism Two-body problem in GR Unruh effect Wormhole

# **Quantum Mechanics (A-H)**

Glossary of QM Adiabatic effect Aharonov–Bohm effect Ang. momentum diagrams Angular momentum op. Bell's theorem **Bra-Ket notation** Canonical commutation rel. Canonical quantization Casimir effect **Classical limit** Commuting observables Correspondence principle Creation and Annihilation Cross section Degenerate energy levels DelayedChoice quant. erase. **Density matrix** Double-slit experiment Ehrenfest theorem EPR paradox **Expectation value** Fock space Free particle Hamiltonian History of QM

### Interpretations

Consistent histories Copenhagen interpretation Interpretations of QM Many-worlds interpretation Quantum Bayesianism Quantum contextuality Relational QM

## Formulations

Heisenberg picture Formulations of QM Matrix mechanics Path integral formulation Phase-space formulation S-matrix Schrödinger equation Schrödinger picture

### Quantum mechanics (I-Z)

Introduction to QM Kochen–Specker theorem Ladder operator List of equations in QM Matter wave Measurement in QM No-cloning theorem Operator Perturbation theory Photoelectric effect **Planck constant** Probability amplitude **Probability current** Quantization Quantum decoherence Quantum entanglement Quantum harmonic osc. Quantum information Quantum mechanics Quantum nonlocality Quantum number Quantum state Quantum superposition Quantum teleportation Quantum tunnelling R. Schrödinger vs. path integral **Rotation operator** Scattering amplitude Slater determinant Symmetry in QM Timeline of QM Topological quantum number Translation operator Uncertainty principle Wave function Wave function collapse Wave packet Wave-particle duality Wheeler's delayed-choice Wigner's theorem Wigner–Weyl transform Zeeman effect

# Thermodynamics

Miscellaneous Adiabatic process Avogadro constant Calorimetry Carnot's theorem Carnot cycle Carnot heat engine Chemical thermod. Clausius theorem Clausius–Clapeyron rel. Convection Degrees of freedom Equation of state Fundamental thermo. rel. Heat engine Heat equation Heat transfer History of thermod. Ideal gas Ideal gas law Irreversible process Isobaric process Isochoric process Isothermal process Joule expansion Laws of thermodynamics Law 0 of thermodynamics Law 1 of thermodynamics Law 2 of thermodynamics Law 3 of thermodynamics Maxwell relations Non-equilibrium thermod. Onsager reciprocal rel. Phase rule Radiation **Real** gas Reversible process Speed of sound State function Supercritical fluid Table of thermo equations Thermal conduction Thermal expansion Thermal radiation Thermodynamics Thermodynamic cycle Thermodynamic eqs. Thermodynamic eq. Thermodynamic process Thermodynamic state Thermodynamic system Van der Waals equation Virial expansion

# Thermodynamics

States of matter \_List of states of matter \_State of matter Gas Liquid Plasma Solid

# System variables

**Chemical potential** Conjugate variables Energy Enthalpy Exergy Gibbs free energy Heat Heat capacity Heat capacity ratio Helmholtz free energy Int. and ext. properties Internal energy List of thermo. properties Mole Pressure Thermod. free energy Thermodynamic potential Vapor pressure Work

# Temperature

Absolute zero Hagedorn temperature -> Kelvin Negative temperature Orders of magnitude Temperature Thermodynamic temp.

# **Thermodynamics**

### Phase transition

**Boiling point** Critical exponent Critical phenomena Critical point Enthalpy of fusion Enthalpy of vaporization **Glass transition** Latent heat Melting point Nucleation Percolation theory Phase Phase diagram Phase transition **Triple point** Universality Universality class Vapor–liquid equilibrium

# **Entropy and Information**

Arrow of time Bekenstein bound Boltzmann entropy formula Boltzmann brain Entropy Entropy and arrow of time Entropy and thermod. Entropy and information Entropy and order/disorder Entropy and stat. thermod. Entropy in thermod./info. Entropy of entanglement Entropy of mixing **Entropy production** Fluctuation theorem Information theory Introduction to entropy Koomey's law Landauer's principle Limits of computation Maxwell's demon **Physical information** Principle of max entropy Quantum computing Quantum information Units of information Von Neumann entropy

# **Statistical mechanics**

Black-body radiation Black body Boltzmann constant Boltzmann distribution **Boltzmann equation** Bose gas Bose–Einstein statistics **Brownian motion** Canonical ensemble Equipartition theorem **Ergodic hypothesis** Fermi gas Fermi–Dirac statistics Fluctuation-dissipation thm. Gibbs paradox Grand canonical ensemble Green–Kubo relations H-theorem Ising model Kinetic theory of gases Liouville's theorem Maxwell–Boltzmann distr. Maxwell–Boltzmann stat. Mean-field theory Microcanonical ensemble Microstate Partition function Photon gas Planck's law Poincaré recurrence thm. Potts model Quantum stat. mechanics Quantum thermodynamics Statistical ensemble Statistical mechanics Stefan–Boltzmann law Thermal wavelength Transport phenomena Wien's displacement law

### Atomic physics

Atom Atomic mass Atomic orbital Atomic physics Atomic theory Azimuthal q-number Block Bohr model Chemical bond **Chemical element Electron configuration Electron shell Energy level** Ext. periodic table Fine structure G-factor (physics) Group (periodic table) Hydrogen atom Hyperfine structure Ionization Ionization energy Isotope Lamb shift Molecule Periodic table Principal g-number Spectral line Spin magnetic moment Spin–orbit interaction Thomas precession Valence electron Zeeman effect

### <u>Cond. m. physics A-E</u> Miscellaneous (A-E)

Band gap **BCS** theory Bloch's theorem B–E condensate Cond. matter physics Crystallization Debye model Density functional th. Density of states Drude model Dyn. mean-field theory Electric properties Electr. band structure Electronic specific heat Electron hole Exchange interaction

## Crystallography

Bravais lattice Brillouin zone Crystal Crystall point group Crystallography Crystal momentum Crystal structure Crystal system Cubic crystal system Miller index Primitive cell Quasicrystal Reciprocal lattice Voronoi diagram Wigner–Seitz cell

# Cond. m. physics F-Z

**Miscellaneous (F-Z)** Fermionic condensate Fermi surface Frac. quantum Hall effect Free electron model Ginzburg–Landau theory Liquid crystal Materials science Polymer Quantum Hall effect Quantum phase trans. Semiconductor Solid-state physics Superconductivity Superfluidity Thermal conductivity Time crystal Val. and cond. Bands

### Magnetism

Antiferromagnetism Diamagnetism Ferromagnetism Hysteresis Magnetic domain Paramagnetism

# Quasiparticles

\_List of quasiparticles Anyon Exciton Phonon Plasmon Polaron Quasiparticle Skyrmion

### **Nuclear physics**

Alpha decay Atomic nucleus Beta decay Decay chain Gamma ray Island of stability List of equations in nuclear and particle ph. Nuclear binding energy Nuclear drip line Nuclear fission Nuclear force Nuclear fusion Nuclear physics Nuclear reaction Nuclear shell model Nuclear structure Nucleosynthesis Nuclide **Radioactive decay** Semi-emp. mass formula Synthetic element Valley of stability

## Relativistic QM

Antimatter Bargmann–Wigner eqs. **Bispinor** Clifford algebra Dirac algebra **Dirac equation Dirac operator Dirac spinor** Gamma matrices Gordon decomposition Higher-dim  $\gamma$ -matrices Joos–Weinberg equation Klein–Gordon equation Majorana equation Orientation entanglem. Pauli equation Pauli matrices Proca action Pseudotensor Rarita–Schwinger eq. Relativistic wave eq. Repr. of Galilean group Repr. of Lorentz group Repr. of Poincaré group Spinor Spinor field Spin Spin connection Spin group Spin quantum number Spin structure Tangloids **Tensor field** Weyl equation Wigner's classification

### <u>QFT (A-P)</u>

Anomaly Beta function Bogoliubov transf. **BRST** quantization **Canonical quantization** Conformal field theory Coupling constant Crossing Dirac sea Dyson series Effective field theory Faddeev–Popov ghost False vacuum Fermionic field Feynman diagram Fock state Gauge anomaly Gauge fixing Gauge symmetry Gauge theory Gauge theory (math) Ghost Goldstone boson Green's function History of QFT Instanton Landau pole Lattice gauge theory List of topics in QFT LSZ reduction formula Minimal coupling Non-perturbative Normal order On shell and off shell Partition function Path-ordering Pauli excl. principle Propagator

## <u>QFT (Q-Z)</u>

Quantum field theory Quantum fluctuation Quantum foam Quantum triviality Quantum vacuum state Quartic interaction Regularization Renormalization **Renormalization group** S-matrix Scalar field theory Scaling dimension Second quantization Seesaw mechanism Self-energy Sigma model Spin-statistics theorem St.F via particle exchge Symmetry in QM Tachyonic field Tachyon condensation **Tensor density Topological QFT** Ultraviolet divergence Vacuum expect. value Vacuum polarization Virtual particle W–T identity Weinberg-Witten thm. Wick's theorem Wick rotation Wightman axioms Wilson loop Yang–Mills equations Yang–Mills theory Yukawa interaction Zero-point energy Zeta f. regularization

### <u>The standard model</u> Miscellaneous

C–G coefficients for SU(3) Cosm. constant problem Fundamental interaction Hierarchy problem Math. formulation of SM Naturalness Standard Model

### **Symmetries**

C-symmetry Chirality Chiral anomaly Chiral symmetry breaking Conformal symmetry CPT symmetry CP violation Helicity Helicity basis Kaon Parity Spont. sym. breaking T-symmetry

## QED

Anom. magnetic moment Fine-structure constant Lorenz gauge condition Precision tests of QED QED vacuum Quantization of EM field QED Schwinger limit

## QCD

Asymptotic freedom CKM matrix Color charge Color confinement Gluon field Gluon field tensor Hadronization Hagedorn temperature Lattice QCD QCD vacuum QCD Quark–gluon plasma Strong CP problem Strong interaction

# Particles

Antiparticle Axion Baryon Baryon number Boson Charge **Eightfold way** Electron Elementary particle Fermion Flavour Generation Glueball Gluon Graviton Hadron Higgs boson Hypercharge **Identical particles** Isospin Lepton Lepton number List of particles Magnetic monopole Majorana fermion Meson Muon Neutrino Neutron Neutron magn. moment Particle physics Particles repr. theory Photon Proton Quark Quark model Tachyon Timeline of discoveries **Timeline particle physics** Top quark Weak hypercharge Weak isospin W and Z bosons

# SM extend GUTS QG

Miscellaneous **Composite Higgs** Dilaton Geometrodynamics Kaluza–Klein theory Leptoquark MUH Noncommutative QFT Noncommutative SM Physics beyond SM Sterile neutrino Technicolor Theory of everything Twistor space Twistor theory 2D conf. field theory WIMPs

### GUTS

B–L Desert Flipped SU(5) Georgi–Glashow model Grand Unified Theory Proton decay SO(10) X-charge X and Y bosons

### **Quantum gravity**

ADM formalism Ashtekar variables Black hole info paradox Canonical QG **Firewall** Ham. constraint of LQG HJE equation Hawking radiation History of LQG Immirzi parameter Loop quantum gravity Lorentz invariance LQG Planck star Problem of time QFT in curved s-t Quantum gravity Quantum spacetime Spin foam Spin network Wheeler–DeWitt eqn.

# **SUSY and Strings**

Supersymmetry Gaugino Gravitino **HLS theorem** Higher-dim. supergravity Lie superalgebra Minimal SuSy SM Neutralino N = 4 SuSy Yang–Mills **R**-parity Sfermion Split supersymmetry Super-Poincaré algebra Superalgebra Supergravity Supermultiplet Superspace SuSy gauge theory Supersymmetric QM Supersymmetry Supersymmetry algebra

#### String theory

AdS/CFT correspondence Bosonic string theory Brane Calabi–Yau manifold Compactification D-brane History of string theory Holographic principle Large extra dimensions M-theory Mirror symmetry Moduli Polyakov action **Regge theory** Relation strings vs. QFT S-duality String String duality String field theory String theory String theory landscape Superstring theory T-duality Virasoro algebra

# Selection of astronomy from Wikipedia

### <u>Astronomy</u>

Solar system Asteroid Asteroid belt Comet Formation solar system Heliosphere Kuiper belt Oort cloud Solar System Sun

### Stars

Brown dwarf Chandrasekhar limit Electron deg. pressure Exotic star H-R diagram Main sequence Neutron star Pulsar Standard solar model Star Stellar classification Stellar evolution Stellar nucleosynthesis Stellar population Stellar structure Supernova Supernova nucleosynth. Type la supernova White dwarf

#### Galaxies

Active galactic nucleus Galaxy Galaxy filament Galaxy evolution Galaxy clusters Gamma-ray burst Milky Way Quasar Void

# <u>Astronomy</u>

Black holes Black hole info paradox Black hole info paradox Black hole thermod. Ergosphere Event horizon Fuzzball Hawking radiation No-hair theorem Planck star Supermass. black hole

Miscellaneous Accretion disk Astronomical object Astronomy Astrophysics Cosmic distance ladder Cosmic ray Degenerate matter Exoplanet Gravitational lens GZK limit History of astronomy Interstellar medium Jeans instability List unsolved problems Natural satellite Nebula Nebular hypothesis Planet Planetary migration Planetary nebula **Planetary system** Redshift

# Astronomy

Cosmology Accelerating expansion Age of the universe Anti-de Sitter space Baryogenesis Baryon acoustic osc. Baryon asymmetry **Big Bang** Big Bang nucleosynthesis **Big Bounce** Chronology of universe Cold dark matter Comoving distances CMB CNB Cosmological constant Cosmology Cyclic model Dark energy Dark matter **Deceleration parameter** De Sitter space **Digital physics** Distance measures **Eternal inflation** Expansion of universe Fine-tuned universe Friedmann equations **FLRW** metric Future of exp. universe Grav. wave background Heat death of universe Horizon problem Hubble's law Hubble volume Inflation Inflaton Lambda-CDM model Leptogenesis Loop quant. cosmology Observable universe Particle horizon Physical cosmology Primordial black hole Primordial fluctuations Reionization Scale factor Shape of the universe String cosmology Structure formation Timeline of theories Timeline early universe Timeline of the far future Ultimate fate of universe Universe Vacuum energy Weyl curvature hyp. Zero-energy universe