PHYSICS (861)

Aims:

1. To enable candidates to acquire knowledge and to develop an understanding of the terms, facts, concepts, definitions, fundamental laws, principles and processes in the field of physics.
2. To develop the ability to apply the knowledge and understanding of physics to unfamiliar situations.
3. To develop a scientific attitude through the study of physical sciences.
4. To develop skills in -
   (a) the practical aspects of handling apparatus, recording observations and
   (b) drawing diagrams, graphs, etc.
5. To develop an appreciation of the contribution of physics towards scientific and technological developments and towards human happiness.
6. To develop an interest in the world of physical sciences.

CLASS XI

There will be two papers in the subject.

Paper I: Theory - 3 hours ... 70 marks

Paper II: Practical - 3 hours ... 20 marks

Project Work … 7 marks

Practical File … 3 marks

PAPER I -THEORY – 70 Marks

Paper I shall be of 3 hours duration and be divided into two parts.

Part I (20 marks): *This part will consist of compulsory short answer questions, testing knowledge, application and skills relating to elementary/fundamental aspects of the entire syllabus.*

Part II (50 marks): *This part will be divided into three Sections A, B and C. There shall be* ***six*** *questions in Section A (each carrying 7 marks) and candidates are required to answer* ***four*** *questions from this Section. There shall be* ***three*** *questions in Section B (each carrying 6 marks) and candidates are required to answer* ***two*** *questions from this Section. There shall be* ***three*** *questions in Section C (each carrying 5 marks) and candidates are required to answer* ***two*** *questions from this Section. Therefore, candidates are expected to answer* ***eight*** *questions in Part II.*

Note: *Unless otherwise specified, only S. I. Units are to be used while teaching and learning, as well as for answering questions.*

SECTION A

1. Role of Physics

(i) Scope of Physics.

(ii) Role of Physics in technology.

(iii) Impact on society.

2. Units

(i) SI units. Fundamental and derived units (correct symbols for units including conventions for symbols).

(ii) Accuracy and errors in measurement, least count of measuring instruments (and the implications for errors in experimental measurements and calculations).

(iii) Significant figures and order of accuracy with reference to measuring instruments. Powers of 10 and order of magnitude.

3. Dimensions

(i) Dimensional formula of physical quantities (from Mechanics only).

(ii) Dimensional equation and its use to check correctness of a formula, to find the relation between physical quantities, to find the dimension of a physical quantity or constant; limitations of dimensional analysis.

4. Vectors, Scalar Quantities and Elementary Calculus

(i) Vectors in one dimension, two dimensions and three dimensions.

(ii) Vector operations (addition, subtraction and multiplication of vectors including use of unit vectors $\hat{i}, \hat{j}, \hat{k}$; parallelogram and triangle law of vector addition).

(iii) Resolution and components of like vectors in a plane (including rectangular components), scalar (dot) and vector (cross) products.

(iv) Elementary Calculus: differentiation and integration as required for physics topics in Classes XI and XII.

5. Dynamics

(i) Cases of uniform velocity, equations of uniformly accelerated motion and applications including motion under gravity (close to surface of the earth).

(ii) Relative velocity, projectile motion.

(iii) Newton's laws of motion and simple applications. Elementary ideas on inertial and uniformly accelerated frames of reference.

(iv) Concurrent forces (reference should be made to force diagrams and to the point of application of forces), work done by constant and variable force (Spring force).

(v) Energy, conservation of energy, power, conservation of linear momentum, impulse, elastic and inelastic collisions in one dimension only.

6. Friction

(i) Friction in solids: static; sliding; rolling.

(ii) Laws of friction. Co-efficient of friction.

7. Motion in Fluids

(i) Equation of continuity of fluid flow and its application, buoyancy, Bernoulli's principle, (venturimeter, pitot tube, atomizer, dynamic uplift).

(ii) Stream line and turbulent flow, Reynold's number (derivation not required).

(iii) Viscous drag; Newton's formula of co-efficient of viscosity.

(iv) Stoke's law, terminal velocity of a sphere falling through a liquid or a hollow rigid sphere rising to the surface of a fluid.

8. Circular Motion

(i) Centripetal acceleration and force, motion round a banked track, point mass at the end of a light, inextensible string and moving in a horizontal circle and as a conical pendulum.

(ii) Centre of mass, moment of inertia: rectangular rod; disc; ring; sphere.

(iii) Parallel axis theorem and perpendicular axis theorem; radius of gyration.

(iv) Torque and angular momentum, relation between torque and moment of inertia and between angular momentum and moment of inertia; conservation of angular momentum and applications.

(v) Two-dimensional rigid body motion, e.g. point mass on string wound on a cylinder (horizontal axis rotation), cylinder rolling down inclined plane without sliding.

9. Gravitation

(i) Newton's law of universal gravitation; gravitational constant (G); gravitational acceleration on surface of the earth (g).

(ii) Relation between G and g; variation of gravitational acceleration above and below the surface of the earth.

(iii) Gravitational field, potential and potential energy.

(iv) Escape velocity (with special reference to the earth and the moon); orbital velocity and period of a satellite in circular orbit (particularly around the earth).

(v) Geostationary satellites - uses of communication satellites.

(vi) Kepler's law of planetary motion.

SECTION B

10. Properties of Matter - Temperature

(i) Properties of matter: Solids: elasticity in solids, Hooke's law, Young's modulus and its determination, bulk modulus and modulus of rigidity, work done in stretching a wire. Liquids: surface tension (molecular theory), drops and bubbles, angle of contact, work done in stretching a surface and surface energy, capillary rise, measurement of surface tension by capillary rise methods. Gases: kinetic theory of gases: postulates, molecular speeds and derivation of $p = \frac{1}{3} \rho \overline{c^2}$, equation of state of an ideal gas $pV = nRT$ (numerical problems not included from gas laws).

(ii) Temperature: kinetic interpretation of temperature (relation between $\overline{c^2}$ and T); absolute temperature. Law of equipartition of energy (statement only).

11. Internal Energy

(i) First law of thermodynamics.

(ii) Isothermal and adiabatic changes in a perfect gas described in terms of curves for PV = constant and PV^{γ} = constant; joule and calorie relation (derivation for PV^{γ} = constant not included).

(iii) Work done in isothermal and adiabatic expansion; principal molar heat capacities; C_p and C_v; relation between C_p and C_v ($C_p - C_v = R$). C_p and C_v for monatomic and diatomic gasses.

(iv) Phase diagram and triple point.

(v) Second law of thermodynamics, Carnot's cycle. Some practical applications.

(vi) Thermal conductivity; co-efficient of thermal conductivity, comparison of thermal and electrical conductivity. Convection with examples.

(vii) Thermal radiation: nature and properties of thermal radiation, qualitative effects of nature of surface on energy absorbed or emitted by it; black body and black body radiation, Stefan's law (using Stefan's law to determine the surface temperature of the sun or a star by treating it as a black body); Newton's law of cooling, Wien's displacement law, distribution of energy in the spectrum of black body radiation (only qualitative and graphical treatment).

SECTION C

12. Oscillations

(i) Simple harmonic motion.

(ii) Expressions for displacement, velocity and acceleration.

(iii) Characteristics of simple harmonic motion.

(iv) Relation between linear simple harmonic motion and uniform circular motion.

(v) Kinetic and potential energy at a point in simple harmonic motion.

(vi) Derivation of time period of simple harmonic motion of a simple pendulum, mass on a spring (horizontal and vertical oscillations).

(vii) Free, forced and damped oscillations (qualitative treatment only). Resonance.

13. Waves

(i) Transverse and longitudinal waves; relation between speed, wavelength and frequency; expression for displacement in wave motion; characteristics of a harmonic wave; graphical representation of a harmonic wave; amplitude and intensity.

(ii) Sound as a wave motion, Newton's formula for the speed of sound and Laplace's correction; variation in the speed of sound with changes in pressure, temperature and humidity; speed of sound in liquids and solids (descriptive treatment only).

(iii) Superimposition of waves (interference, beats and standing waves), progressive and stationary waves.

(iv) Laws of vibrations of stretched strings.

(v) Modes of vibration of strings and air columns; resonance.

(vi) Doppler Effect for sound.

NOTE: *Numerical problems are included from all topics except where they are specifically excluded or where only qualitative treatment is required.*

PAPER II

PRACTICAL WORK- 20 Marks

The following experiments are recommended for practical work. The teacher may alter or add.

1. Measurement by Vernier callipers. Measure the diameter of a spherical body. Calculate the volume with appropriate significant figures. Measure the volume using a graduated cylinder and compare it with calculated value.
2. Find the diameter of a wire using a micrometer screw gauge and determine percentage error in cross sectional area.
3. Determine radius of curvature of a spherical surface like watch glass by a spherometer.
4. Equilibrium of three concurrent coplanar forces. To verify the law of parallelograms of forces and to determine weight of a body.
5. Inclined plane: To find the downward force acting along the inclined plane on a roller due to gravitational pull of earth and to study its relationship with angle of inclination by plotting graph between force and sin θ.
6. Friction: To find the force of kinetic friction for a wooden block placed on horizontal surface and to study its relationship with normal reaction. To determine the coefficient of friction.
7. To find the acceleration due to gravity by measuring the variation in time period (T) with effective length (L) of simple pendulum; plot graph of T νs $\sqrt{L}$ and T^2 νs L.
8. To find the force constant of a spring and to study variation in time period of oscillation of a body suspended by the spring. To find acceleration due to gravity by plotting graph of T against $\sqrt{m}$.
9. Oscillation of a simple meter rule used as bar pendulum. To study variation in time period (T) with distance of centre of gravity from axis of suspension and to find radius of gyration and moment of inertia about an axis through the centre of gravity.
10. Boyle's Law: To study the variation in volume with pressure for a sample of air at constant temperature by plotting graphs between p and $1/V$ and between p and V.
11. Cooling curve: To study the relationships between temperature of a body (like hot water or liquid in calorimeter) with time. Find the slope of curve at four different temperatures of hot body and hence deduce Newton's law of cooling.
12. Determine Young's modulus of elasticity using Searle's apparatus.
13. To study the variation in frequency of air column with length resonance of air columns using tall cylinder and set of tuning forks. Hence determine velocity of sound at room temperature.
14. To determine frequency of a tuning fork using a sonometer.
15. To verify laws of vibration of strings using a sonometer.

PROJECT WORK AND PRACTICAL FILE – 10 Marks

Project Work – 7 Marks

All candidates will do project work involving some Physics related topics, under the guidance and regular supervision of the Physics teacher. Candidates are to prepare a technical report formally written including an abstract, some theoretical discussion, experimental setup, observations with tables of data collected, analysis and discussion of results, deductions, conclusion, etc. (after the draft has been approved by the teacher). The report should be kept simple, but neat and elegant. No extra credit shall be given for type-written material/decorative cover, etc. Teachers may assign or students may choose any one project of their choice.

Practical File – 3 Marks

Teachers are required to assess students on the basis of the Physics practical file maintained by them during the academic year.

CLASS XII

There will be two papers in the subject.

Paper I: Theory - 3 hours ... 70 marks

Paper II: Practical - 3 hours ... 20 marks
Project Work … 7 marks
Practical File … 3 marks

PAPER I -THEORY- 70 Marks

Paper I shall be of 3 hours duration and be divided into two parts.

Part I (20 marks): *This part will consist of compulsory short answer questions, testing knowledge, application and skills relating to elementary/fundamental aspects of the entire syllabus.*

Part II (50 marks): *This part will be divided into three Sections A, B and C. There shall be* ***three*** *questions in Section A (each carrying 9 marks) and candidates are required to answer* ***two*** *questions from this Section. There shall be* ***three*** *questions in Section B (each carrying 8 marks) and candidates are required to answer* ***two*** *questions from this Section. There shall be* ***three*** *questions in Section C (each carrying 8 marks) and candidates are required to answer* ***two*** *questions from this Section. Therefore, candidates are expected to answer* ***six*** *questions in Part II.*

Note: *Unless otherwise specified, only S. I. units are to be used while teaching and learning, as well as for answering questions.*

SECTION A

1. Electrostatics

(i) Coulomb's law, S.I. unit of charge; permittivity of free space.

(ii) Concept of electric field $E = F/q_o$; Gauss' theorem and its applications. Van de Graff generator.

(iii) Electric dipole; electric field at a point on the axis and perpendicular bisector of a dipole; electric dipole moment; torque on a dipole in a uniform electric field.

(iv) Electric lines of force.

(v) Electric potential and potential energy; potential due to a point charge and due to a dipole; potential energy of an electric dipole in an electric field.

(vi) Capacitance C = Q/V, the farad; capacitance of a parallel-plate capacitor; capacitance in series and parallel combinations; energy $U = {}^1/_2CV^2$.

(vii) Dielectrics (elementary ideas only); permittivity and relative permittivity of a dielectric ($\in_r = \in/\in_o$). Effects on pd, charge and capacitance.

2. Current Electricity

(i) Steady currents; sources of current, simple cells, secondary cells (cell action).

(ii) Potential difference as the power supplied divided by the current; Ohm's law and its limitations; Combinations of resistors in series and parallel; Electric energy and power.

(iii) Mechanism of flow of current in metals, drift velocity of charges. Resistance and resistivity and their relation to drift velocity of electrons; description of resistivity and conductivity based on electron theory; effect of temperature on resistance, colour coding of resistance.

(iv) Electromotive force in a cell; internal resistance and back emf. Combination of cells in series and parallel.

(v) Kirchhoff's laws and their simple applications to circuits with resistors and sources of emf; Wheatstone bridge, metre-bridge and potentiometer; use for comparison of emf and determination of internal resistance of sources of current; use of resistors (shunts and multipliers) in ammeters and voltmeters.

(vi) Heating effect of a current (Joule's law).

(vii) Thermoelectricity; Seebeck effect; measurement of thermo emf; its variation with temperature.

3. Magnetism

(i) Magnetic field $\overline{\mathcal{B}}$, definition from magnetic force on a moving charge; magnetic field lines. Superposition of magnetic fields; magnetic field and magnetic flux density; the earth's magnetic field; tangent law.

(ii) Properties of dia, para and ferromagnetic substances; susceptibility and relative permeability

4. Electromagnetism

(i) Oersted's experiment; Biot-Savart law, the tesla; magnetic field near a long straight wire, at the centre of a circular loop, and at a point on the axis of a circular coil carrying current. Amperes circuital law and its application to obtain magnetic field due to a long straight wire and inside a long solenoid; tangent galvanometer.

(ii) Force on a moving charge in a magnetic field; force on a current carrying conductor moving in a magnetic field; force between two parallel current carrying wires; definition of the ampere based on the force between two current carrying wires. Cyclotron (simple idea).

(iii) A current loop as a magnetic dipole; magnetic dipole moment; torque on a current loop; moving coil galvanometer.

(iv) Electromagnetic induction, magnetic flux and induced emf; Faraday's law and Lenz's law; transformers; eddy currents.

(v) Mutual and self inductance: the Henry. Growth and decay of current in LR circuit (dc) (graphical approach), time constant.

(vi) Simple a.c. and d.c. generators.

5. Alternating Current Circuits

(i) Change of voltage and current with time, the phase difference; peak and rms values of voltage and current; their relation in sinusoidal case.

(ii) Variation of voltage and current in a.c. circuits consisting of only resistors, only inductors and only capacitors (phasor representation), phase lag and phase lead.

(iii) The LCR series circuit: phasor diagram, expression for V or I; phase lag/lead; impedance of a series LCR circuit (arrived at by phasor diagram); Special cases for RL and RC circuits.

(iv) Power P associated with LCR circuit $= {}^{1}/_{2} V_o I_o \cos\phi = V_{rms} I_{rms} \cos\phi$; power absorbed and power dissipated; choke coil (choke and starter); electrical resonance; oscillations in an LC circuit ($\omega = 1/\sqrt{LC}$).

SECTION B

6. Wave Optics

(i) Complete electromagnetic spectrum from radio waves to gamma rays; transverse nature of electromagnetic waves, Huygen's principle; laws of reflection and refraction from Huygen's principle.

(ii) Conditions for interference of light, interference of monochromatic light by double slit; measurement of wave length.

(iii) Single slit Fraunhoffer diffraction (elementary explanation).

(iv) Plane polarised electromagnetic wave (elementary idea), polarisation of light by reflection and refraction, Brewster's law; polaroids.

7. Ray Optics and Optical Instruments

(i) Refraction of light at a plane interface (Snell's law); total internal reflection and critical angle; total reflecting prisms and optical fibres.

(ii) Refraction through a prism, minimum deviation and derivation of relation between n, A and δ_{min}.

(iii) Refraction at a spherical surface (relation between n_1, n_2, u, v and R); refraction through thin lens (lens maker's formula and formula relating u, v, f, n, R_1 and R_2); combined focal length of two thin lenses in contact. Combination of lenses and mirrors.

(iv) Dispersion; dispersive power; production of pure spectrum; spectrometer and its setting (experimental uses and procedures included); absorption and emission spectra; spherical and chromatic aberration; derivation of condition for achromatic combination of two thin lenses in contact.

(v) Simple microscope; Compound microscope and their magnifying power.

(vi) Simple astronomical telescope (refracting and reflecting), magnifying power and resolving power of a simple astronomical telescope.

SECTION C

8. Electrons and Photons

(i) Cathode rays: measurement of e/m for electrons; principle of cathode ray oscillograph.

(ii) Photo electric effect, quantization of radiation; Einstein's equation; threshold frequency; work function; energy and momentum of photon. Determination of Planck's Constant from photo electric effect.

(iii) Wave particle duality, De Broglie equation, phenomenon of electron diffraction (informative only).

9. Atoms

(i) Charge and size of molecules (α-particle scattering); atomic structure; Bohr's postulates, Bohr's quantization condition; radii of Bohr orbits for hydrogen atom; energy of the hydrogen atom in the nth state; line spectra of hydrogen and calculation of E and f for different lines.

(ii) Production of X-rays; maximum frequency for a given tube potential. Characteristic and continuous X -rays. Mosley's law

10. Nuclei

(i) Atomic masses; unified atomic mass unit u and its value in MeV; the neutron; composition of nucleus; mass defect and binding energy.

(ii) Radioactivity: nature and properties of alpha, beta and gamma radiation; radioactive decay law, half-life, mean life and decay constant.

11. Nuclear Energy

(i) Energy - mass equivalence.

(ii) Nuclear fission; chain reaction; principle of operation of a nuclear reactor.

(iii) Nuclear fusion; thermonuclear fusion as the source of the sun's energy.

12. Semiconductor Devices

(i) Energy bands in solids; energy band diagrams for distinction between conductors, insulators and semi-conductors - intrinsic and extrinsic; electrons and holes in semiconductors.

(ii) Junction diode; depletion region; forward and reverse biasing current - voltage characteristics; pn diode as a half wave and full wave rectifier; solar cell, LED and photodiode.

(iii) The junction transistor; npn and pnp transistors; current gain in a transistor; transistor (common emitter) amplifier (only circuit diagram and qualitative treatment) and oscillator.

(iv) Elementary idea of discreet and integrated circuits, analogue and digital circuits. Logic gates (symbols; working with truth tables; applications and uses) - NOT, OR, AND, NOR, NAND.

PAPER II

PRACTICAL WORK- 20 Marks

The experiments for laboratory work and practical examinations are mostly from two groups; (i) experiments based on ray optics and (ii) experiments based on current electricity. The main skill required in group (i) is to remove parallax between a needle and the real image of another needle. In group (ii), understanding circuit diagram and making connections strictly following the given diagram is very important. Take care of polarity of cells and meters, their range, zero error, least count, etc. Another very important part is graph. Usually, there are two graphs in all question papers. Students should learn to draw graphs correctly noting all important steps such as title, selection of origin, labelling of axes (not x and y), proper scale and the units given along each axis. Use maximum area of graph paper, plot points with great care, mark the points plotted with x or $\otimes$ and draw the best fit straight line (not necessarily passing through all the plotted points), keeping all experimental points symmetrically placed (on the line and on the left and right side of the line) with respect to the best fit thin straight line. Read intercepts, slopes as required, carefully reading fraction of a division.

NOTE:

1. Short answer questions may be set from each experiment to test understanding of theory and logic of steps involved.
2. Questions (experiments) asked in annual examinations conducted by the Council may be discussed/ attempted.

The list of experiments given below is only general recommendation. Teachers may add, alter or modify this list, keeping in mind the general pattern of questions asked in the annual examinations.

1. Draw the following set of graphs using data from lens experiments -
   i) v against u. It will be a curve.
   ii) Magnification $\left(m\left(=\frac{v}{u}\right)\right.$ against ν and to find focal length by intercept.
   iii) $y = 100/v$ against $x = 100/u$ and to find f by intercepts.
2. To find f of a convex lens by using u-v method.
3. To find f of a convex lens by displacement method.
4. Coaxial combination of two convex lenses not in contact.
5. Using a convex lens, optical bench and two pins, obtain the positions of the images for various positions of the object; $f<u<2f$, $u\sim2f$, and $u>2f$. Plot a graph of $y = 100/u$ versus $x = 100/v$. Obtain the focal length of the lens from the intercepts read from the graph.
6. Determine the focal length of a concave lens, using an auxiliary convex lens, not in contact and plotting appropriate graph.
7. Refractive index of material of lens by Boys' method.
8. Refractive index of a liquid by using convex lens and plane mirror.
9. Using a spectrometer, measure the angle of the given prism and the angle of minimum deviation. Calculate the refractive index of the material. [A dark room is not necessary].
10. Set up a deflection magnetometer in Tan-A position, and use it to compare the dipole moments of the given bar magnets, using (a) deflection method, neglecting the length of the magnets and (b) null method.
11. Set up a vibration magnetometer and use it to compare the magnetic moments of the given bar magnets of equal size, but different strengths.
12. Determine the galvanometer constant of a tangent galvanometer measuring the current (using an ammeter) and galvanometer deflection, varying the current using a rheostat. Also, determine the magnetic field at the centre of the galvanometer coil for different values of current and for different number of turns of the coil.
13. Using a metre bridge, determine the resistance of about 100cm of constantan wire, measure its length and radius and hence calculate the specific resistance of the material.
14. Verify Ohm's law for the given unknown resistance (a 60cm constantan wire), plotting a graph of pd versus current. From the slope of the graph and the length of the wire, calculate the resistance per cm of the wire.
15. From a potentiometer set up, measure the fall in potential for increasing lengths of a constantan wire, through which a steady current is flowing; plot a graph of pd V versus length l. Calculate the potential gradient of the wire. Q (i) Why is the current kept constant in this experiment? Q (ii) How can you increase the sensitivity of the potentiometer? Q (iii) How can you use the above results and measure the emf of a cell?
16. Compare the emf of two cells using a potentiometer.
17. To study the variation in potential drop with length of slide wire for constant current, hence to determine specific resistance.
18. To determine the internal resistance of a cell by potentiometer device.
19. Given the figure of merit and resistance of a galvanometer, convert it to (a) an ammeter of range, say 2A and (b) a voltmeter of range 4V. Also calculate the resistance of the new ammeter and voltmeter.

PROJECT WORK AND PRACTICAL FILE – 10 Marks

Project Work – 7 Marks

The Project work is to be assessed by a Visiting Examiner appointed locally and approved by the Council.

All candidates will do project work involving some physics related topics, under the guidance and regular supervision of the Physics teacher.

Candidates are to prepare a technical report formally written including an abstract, some theoretical discussion, experimental setup, observations with tables of data collected, analysis and discussion of results, deductions, conclusion, etc. (after the draft has been approved by the teacher). The report should be kept simple, but neat and elegant. No extra credit shall be given for typewritten material/decorative cover, etc. Teachers may assign or students may choose any one project of their choice.

Practical File – 3 Marks

The Visiting Examiner is required to assess students on the basis of the Physics practical file maintained by them during the academic year.

A NOTE ON SI UNITS

SI units (*Systeme International d'Unites*) were adopted internationally in 1968.

Fundamental units

The system has seven fundamental (or basic) units, one for each of the fundamental quantities.

Fundamental quantity	**Unit**	
	Name	**Symbol**
Mass	kilogram	kg
Length	metre	m
Time	second	s
Electric current	ampere	A
Temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Derived units

These are obtained from the fundamental units by multiplication or division; no numerical factors are involved. Some derived units with complex names are:

Derived quantity	**Unit**	
	Name	**Symbol**
Volume	cubic metre	m^3
Density	kilogram per cubic metre	kg m^{-3}
Velocity	metre per second	m s^{-1}
Acceleration	metre per second squared	m s^{-2}
Momentum	kilogram metre per second	$kgms^{-1}$

Some derived units are given special names due to their complexity when expressed in terms of the fundamental units, as below:

Derived quantity	**Unit**	
	Name	**Symbol**
Force	newton	N
Pressure	pascal	Pa
Energy, Work	joule	J
Power	watt	W
Frequency	hertz	Hz
Electric charge	coulomb	C
Electric resistance	ohm	Ω
Electromotive force	volt	V

When the unit is named after a person, the *symbol* has a capital letter.

Standard prefixes

Decimal multiples and submultiples are attached to units when appropriate, as below:

Multiple	**Prefix**	**Symbol**
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f