The Standards of Weights and Measures (National Standards) Rules, 1988

UNION OF INDIA
India

The Standards of Weights and Measures (National Standards) Rules, 1988

Rule THE-STANDARDS-OF-WEIGHTS-AND-MEASURES-NATIONAL-STAND of 1988

- Published on 16 November 1988
- Commenced on 16 November 1988
- [This is the version of this document from 16 November 1988.]
- [Note: The original publication document is not available and this content could not be verified.]

The Standards of Weights and Measures (National Standards) Rules, 1988Published Vide Notification G.S.R. 1076(E), dated 16-11-1988, published in the Gazette of India, Extra, 2, Section 3(i), dated 16-11-1988

1010.

G.S.R. 1076 (E) dated 16.11.1988. - In exercise of the powers conferred by section 83 of the Standards of Weights and Measures Act, 1976 (60 of 1976), the Central Government hereby makes the following rules, namely:-

Vide G.S.R. 1076(E), dated 16-11-1987, published in the Gazette of India, Ext., Pt. II, section 3(i), dated 16-11-1988.

Chapter I
Preliminary

1. Short title and commencement

(1);These rules may be called The Standards of Weights and Measures (National Stan-dards) Rules, 1988.(2);They shall come into force on the date of their publication in the Official Gazette.

2. Definitions

- In these rules, unless the context otherwise requires,--(a);"Act" means the Standards of Weights and Measures Act, 1976 (60 of 1976);(b);"coefficient" means those parameters without physical dimensions or ratios of quantities of the same kind, which are necessary for particular measurements or for characterising properties of substances or mixtures of certain substances.IllustrationDegree of alcoholic strength, percentage of sugar, and hardness of materials, are examples of coefficients;(c);"derived units" means units, expressed algebraically in terms of base units, or in terms of base and supplementary units of weights or measures, by means of mathematical symbols of multiplication or division, or both.Explanation I.- Derived units having special names and symbols (such as "newton", with symbol N') may, by themselves, be used to express other derived units in a simpler way than in terms of the base units of weights and measures.Explanation II.-The values of dimensionless quantities (such as refractive index, specific gravity, relative permeability or relative permittivity) are expressed by numbers. In such cases the corresponding unit shall be the ratio of the relevant two units and may be expressed by a number;(d);"International System of Units" of weights and measures means "Le System International d' Units", with the international abbreviation SI' established by the General Conference on Weights and Measures.Explanation.- SI' is divided into three classes of units, namely,--(i);base units, as defined in the Act;(ii);derived units; and(iii);supplementary units;(e);"permitted units" means the units which though not part of the SI, are recognised and permitted by the General Conference on Weights and Measures for general use along with SI units;(f);"physical constants" means those constants which express the value of physical invariants in a given system of units. These constants includes,--(i);those which correlate two or more physical quantities to express a physical phenomenon in quantitative terms independent of any material properties; for example, gravitational constant, velocity of light, etc.(ii);those which correlate the microscope properties of elementary particles (atoms, molecules, etc.) to the corresponding macroscopic properties; for example; Avogadro constant, Faraday constant, etc.(iii);those conversion factors used to express the same parameter in terms of inde-pendently defined units; for example, the conversion factor relating the astro-nomical unit or parasec to the metre and atomic mass unit to kilogram;(iv);those which describe the material properties of pure substances, for example, thermal conductivity, specific resistance, etc.(g);"Schedule" means Schedule appended to these rules;(h);"SI prefix" means the name and symbol of a prefix used for forming decimal multiples and sub-multiples of SI units, and of such other units as are permitted subject to any exception or modification by the General Conference on Weights and Measures or the International Organisation of Legal Metrology, or both, to be used along with the SI units;(i);"special units" means units, outside the SI, which are ordinarily used in specialised fields of scientific research. The values of those units expressed in SI units can only be obtained by experiment, and are, therefore, not known exactly.Explanation.-The value of electron volt (the unit of energy) depends upon the experimen-tally determined value of the charge of an electron;(j);"supplementary units" means the units of weight or measure which have been specified as such by the General Conference on Weights and Measures.Explanation.-Supplementary units may be used to form derived units;(k);"symbol" means a letter or a group of letters, written or combined in the specified manner for the convenient representation of a unit or a group of units;(l);"temporarily accepted units" means the units of weight or measure which have been recognised for the time being by the General Conference on

Weights and Measures, for use along with SI units.

Chapter II
Units Of Weight Or Measure

3. Rules of construction

- In these rules, wherever the expression "weight" has been used as symbolising the quantity of matter, such expression shall be construed as representing mass.

4. Supplementary units

- The units defined and specified in Schedule I shall be the supplementary units and the symbol assigned to each such unit in that Schedule shall be the symbol of that unit.

5. Derived units

- The units defined and specified in Schedule II shall be derived units and the symbol assigned to each such unit in that Schedule shall be the symbol of that unit and no other units shall be used for the entities specified in Schedule II except for the purpose of scientific or technological research.

6. Decimal multiples and sub-multiples of units

(1)Decimal multiples and sub-multiples of base, supplementary, derived or other units shall be formed, unless otherwise specified, by using either the full name, or symbol of the SI prefix specified in Schedule III.(2)The SI prefixes shall be used in the manner specified in Schedule III.

7. Permitted units

(1)The units specified in Schedule IV may be used along with the SI units, subject to such limitations as are specified in that Schedule.(2);The multiples and sub-multiples of the units of time and plane angle specified in Schedule IV, shall be formed only in the manner specified in the Schedule.

8. Special units

(1)The units specified in Schedule V shall be used in such manner that their values may be expressed in terms of such SI unit or combination of SI units, as may be appropriate.(2);The multiples and sub-multiples of the units specified in Schedule V shall be formed with the help of SI prefixes specified in Schedule III.

9. Temporarily accepted units

- The unit of weight or measure specified in Schedule VI may also be used, subject to the condition that the Central Government shall, at least once in every ten years after the commence-ment of these rules, review the need, or otherwise, for the continuance for general use of such units:Provided that such review may be undertaken earlier by the Central Government either on its own motion or on the basis of a recommendation made by the General Conference on Weights and Measures, or the International Organisation of Legal Metrology.

10. Units which should be progressively discontinued

(1)Subject to the provisions of sub-rule (2), the CGS (i.e., centrimetre, gram, second) units specified in Schedule VII, and the units of weights and measures specified in Schedule VIII (being units outside the SI), shall not ordinarily be used except for the purpose of scientific and technological research and no such unit shall ordinarily be used for the purpose of teaching.(2)The use of the units specified in Schedule VII or, as the case may be, Schedule VIII, shall be progressively discontinued so that no such unit is used in any field (except in the field of scientific and technological research) after the expiry of a period of ten years from the commencement of these rules.(3)While using, for the purpose of scientific and technological research the units specified in Schedule VII, or, as the case may be, the Schedule VIII, such units shall be used only with the corresponding symbols specified in the said Schedules.

11. Physical constants

- The physical constants specified in Schedule IX and their corresponding numerical values shall be used for all purposes except for the purposes of research connected with determination of their values.

12. Coefficient and symbol

(1)Coefficients include the terms defined and specified in Schedule X; the symbol as-signed to any such coefficient in that Schedule shall be the symbol of such coefficient.(2)Ordinarily, the coefficients and their respective symbols specified in Schedule X shall be used:Provided that any coefficient which is not specified in Schedule X but which corresponds to any coefficient specified in that Schedule, may be used for a period of five years from the commencement of these rules:Provided further where any new coefficient added in Schedule X, any coefficient corresponding to the coefficient so added may be used for a period of five years from the date of addition of such coefficient.(3)On the expiry of the period of aforesaid five years, the use of coefficient and their respective symbols as specified in Schedule X shall be compulsory.Explanation.-In the case of a coefficient the use of which is permissible under any of the provisos to sub-rule (2), the symbol, if any, attached to such coefficient may also be used for the same period for which the corresponding coefficient is permitted to be used.

13. Formation of new units

- No new unit of weight or measure shall be formed or used except for the purpose of scientific and technological research, without the previous approval of the Central Government.

Chapter III
National Standards

14. Custody, maintenance, etc., of national standards of weights and measures

(1)The work relating to the realisation, establishment, custody, maintenance, determination, reproduction and updating of national standards of weights and measures shall, on the commencement of these rules, be the responsibility of the National Physical Laboratory.(2)The Central Government may call for such reports from, or issue such directions to, the National Physical Laboratory as it may think fit, in relation to all or any of the matters specified in sub-rule (1).

15. Realisation and establishment of the national standards of weights and measures based on SI units

(1);The National Physical Laboratory shall discharge the responsibility of realising and establishing the national standards of weights and measures on the basis of recommendations made from time to time, by the General Conference on Weights and Measures or the Interna-tional Organisation of Legal Metrology, as the case may be.(2);The standards of weights and measures, so realised and established, shall be self-con-sistent.(3);For the purpose of establishing the national standards for the base units other than that of mass, the National Physical Laboratory shall--(a);prepare or cause to be prepared such objects, or equipments, or reproduce such phenomena, or both, as may be necessary for the purpose; and(b);determine or cause to be determined the values of the national standards as recommended by the General Conference on Weights and Measures and intercompare them, or cause them to be intercompared, with the corresponding international standards.(4);For the purpose of deriving the value of the kilogram, the National Physical Laboratory shall arrange the periodical determination of the value of the national prototype of the kilogram in terms of the international prototype of the kilogram and the national prototype of the kilogram, the value of which is so determined, shall be the national standard of mass.(5);For the purpose of establishing the national standards for the derived and supplemen-tary units, the National Physical Laboratory shall prepare such standards, or objects or equip-ments, or both, and determine periodically their values and accuracy in relation to the national standards of base units.

16. Custody and maintenance of prototype standards

(1);The national prototype of the kilogram and other standards, equipments and objects shall remain in the custody of the National Physical Laboratory.(2);The national prototype of the kilogram, and every other national standard, standard equipment and object shall be maintained and realised periodically in accordance with such instructions as the General Conference on Weights and Measures or the International Organisation of Legal Metrology or any organisation constituted by either of them may issue from time to time.(3);Where no instructions have been issued by the International Organisation referred to in sub-rule (2), any consultative committee constituted, may compile instructions for the proper maintenance of national prototype, national standards, standard equipment and objects.(4);The National Physical Laboratory shall arrange, where necessary, to have the national prototype and national standards of physical measurements realised and established in accor-dance with the recommendations of the General Conference on Weights and Measures and to get them calibrated or intercompared with reference to the appropriate international standards of physical measurements, at periodical intervals of not more than ten years.(5);The value of the national prototype and other national standards shall be the value determined by the National Physical Laboratory or assigned by the National Physical Labora-tory on the basis of the technical information provided by the International Bureau of Weights and Measures. The National Physical Laboratory shall publish such values periodically but in any case at least once in every five years.(6);The value determined in accordance with sub-rule (5) shall be deemed to represent the highest obtainable accuracy of such value in the country.

Chapter IV
Reference, Secondary And Working Standards

17. Standards which are to be fabricated by the Mint

- Unless otherwise specified by the Central Government, all the reference, secondary and working standards of mass and length and secondary and working standards of capacity shall be fabricated by the Metrological Wing of the Government of India Mint at Bombay.

18. Places where reference, secondary and working standards be kept

(1);There shall be established by the Central Government, at such places as it may think fit, Reference Standard Laboratories for maintaining such reference, secondary and working standards as may be needed by the Central Government for the purpose of the Act.(2);The Indian Institute of Legal Metrology or any other laboratory specified by the Central Government for this purpose may also maintain such reference, secondary and working standards, as may be necessary, for their functioning as a metrological laboratory of the level of a Reference Standard Laboratory.(3);The Government of India Mint at Bombay may also maintain such reference, secondary and working standards as may be necessary for carrying out the work referred to in rule 17.

19. Period and manner of verification of reference, secondary and working standards

(1);Every reference standard shall be verified and certified in terms of the National Standards by the National Physical Laboratory, at an interval not exceeding three years:Provided that in the case of length measures such interval shall not exceed five years.(2);Every secondary standard shall be verified against the appropriate reference standard by the Reference Standard Laboratory, at an interval not exceeding two years.(3);Every working standard shall be verified against the appropriate secondary standard, by any of the laboratories where secondary standards are maintained, at an interval not exceeding one year.

20. Maintenance of reference, secondary and working standards

- Every reference standard, every secondary standard and every working standard, irrespec-tive of the place where they are kept, shall be maintained as far as practicable in accordance with the guidelines issued by the National Physical Laboratory from time to time.

I

Supplementary Units And Their Symbols(See rule 4)

1. Units of plane angle. - The unit of plane angle shall be the radian (symbol: rad)

The radian is the plane angle between two radii of a circle which cut off, on the circumference, an arc equal in length to the radius.

2. Unit of solid angle.-The unit of solid angle shall be the steradian. (Symbol: sr)

The steradian is the solid angle which, having its vertex in the centre of a sphere, cuts off an area of the surface of the sphere equal to that of a square with sides of length equal to the radius of the sphere.

II

(See rule 5)Derived Units And Their Symbols

Part I – Derived Units In Relation To Space And Time

1. Unit of area.-The unit of area shall be the square metre. (Symbol: m2)

The square metre is the area of a square with sides of one metre each.

2. Unit of volume. - The unit of volume shall be the cubic metre (Symbol: m2)

The cubic metre is the volume of a cube with sides of one metre each.

3. Unit of frequency. - The unit of frequency shall be the hertz. (Symbol: Hz)

The hertz is the frequency of a periodic phenomenon, the period of which is one second,

1 Hz= 1 =s-1

1s

4.

Unit of angular velocity. - The unit of angular velocity shall be the radian per second. (Symbol: rad/s)The radian per second is the angular velocity of a body, rotating around a fixed axis, which rotates through one radian in one second, when set in uniform rotation.

5.

Unit of angular acceleration.- The unit of angular acceleration shall be the radian per second squared.(Symbol: rad/s2)The radian per second squared is the angular acceleration of a body, rotating around a fixed axis, which when set into a uniformly varying rotation, changes angular velocity at the rate of one radian per second in one second.

6. Unit of speed and velocity.-The unit of speed and velocity shall be the metre per second.

(Symbol: m/s or ms-1)The metre per second is the velocity (speed) of a body in motion which traverses a distance of one metre in one second when set in uniform motion.

7. Unit of acceleration.-The unit of acceleration shall be the metre per second squared.

(Symbol: m/s2 of ms-2)The metre per second squared is the acceleration of a body in motion which, when set in a uniformly varying motion, changes its velocity at the rate of one metre per second in one second.

8. Unit of rotational frequency.-The unit of rotational frequency shall be the second raised to the power minus one.

(Symbol:s-1)The second raised to the power minus one is the rotational frequency of a uniform rotatory movement which produces one complete revolution in one second.Note 1.-This unit is also called: revolutions per second.Note 2.-The unit "revolutions per minute" may also be used.

9. Unit of wave number.- The unit of wave number shall be the metre raised to the power minus one.

(Symbol: m-1)The metre raised to the power minus one is the number of waves of a monochromatic radiation which can be accommodated, in the direction of its propagation, in a length equal to one metre.

10. Unit of vergency of optical system.-The unit of vergency of optical system shall also be the metre raised to the power minus one.

(Symbol: m-1)The metre raised to. the power minus one is the vergency of an optical system, the focal distance of which is one metre in a medium having unit refractive index.Note 1.-This unit is also called "per metre" or "dioptre".Note 2.-The metre raised to the power minus one with symbol m' is the unit of wave number as well as that of vergency of optical system. The context in which the said unit is used will indicate whether the unit relates to the wave number or vergency of optical system.

Part II

Derived Units In Relation To Mechanics

1. Units of density and mass density.-The unit of density and mass density shall be the kilogram per cubic metre.

(Symbol: kg/m3 or kg m-3)The kilogram per cubic metre is the density or mass density of a homogeneous body having a mass of one kilogram and a volume of one cubic metre.

2. Unit of concentration.-The unit of concentration shall be the kilogram per cubic metre.

(Symbol: kg/m3 or kg m-3)The kilogram per cubic metre is the concentration of a homogeneous solution having a total volume of one cubic metre and containing a mass of one kilogram of the given substance.

3. Unit of force.-The unit of force shall be the newton

(Symbol: N)The newton is the force which gives to a mass of one kilogram an acceleration of one metre per second squared.

1N.

=1kg Im/s2=1kg ms-2

4. Unit of moment of force.-The unit of moment of force shall be the metre newton.

(Symbol: N. m)The metre newton is the moment of force produced in a body by a force of one newton acting at a perpendicular distance of one metre from the fixed axis around which the body turns.

1N.

m=1m2kg.s-2Note.-The unit of moment of force shall not be written as joule (J) just because it is N. m.

5. Unit of pressure.-The unit of pressure shall be the pascal.

(Symbol: Pa)The pascal is the pressure which, acting on a plane surface of one square metre exerts on that area a total force of one newton.

1 Pa IN or 1 Nm-2= 1 kg m-1s-2
m2

6. Unit of tensile strength.-The unit of tensile strength shall be the mega pascal.

(Symbol: MPa or MN/m2)The tensile strength is the highest force, when applied normal to the cross section of a test piece which it can withstand, divided by the original area of the cross-section.

7. Unit of dynamic viscosity.-The unit of dynamic viscosity shall be the pascal second.

(Symbol: Pa. s)The pascal second is the dynamic viscosity of a homogenous liquid in which the straight and uniform movement of a plane surface of one square metre produces a retarding force of one newton, when there is a velocity difference of one metre per second between two parallel planes separated by one metre.

1 Pa.s = 1 Pa.m2 m-1kgs-1

ms-1.m

8. Unit of kinematic viscosity.-The unit of kinematic viscosity shall be the square metre per second.

(Symbol: m2/s or m2.s-1)The square metre per second is the kinematic viscosity of a liquid which has a dynamic viscosity of one pascal second and a density of one kilogram per cubic metre.

1 m2 = 1Pa/1s

1s 1 kg/m3

9. Unit of surface tension. - The unit of surface tension shall be the newton per metre.

(Symbol: N/m)The newton per metre is the surface tension produced when a force of one newton acts over a length of one metre on the surface of a liquid separating the liquid from the material surrounding it.

10. Unit of work, energy and quantity of heat.-The unit of energy, work and quantity of heat shall be the joule.

(Symbol: J)The joule is the work done when the point of application of force of one newton moves a distance of one metre in the direction of the force.

1J.

=1N.1m

11. Unit of power, radiant flux and heat flux.-The unit of power, radiant flux and heat flux shall be the watt.

(Symbol: W)The watt is the power of an energy system in which one joule of energy is uniformly transferred in one second.

1W.

=1J/1s=1Js-1

12. Unit of volume flow.-The unit of volume flow shall be the cubic metre per second.

(Symbol : m3/s or m3s-1)The cubic metre per second is the volume delivered by the uniform discharge of one cubic metre traversing the given cross-section in one second.

13. Unit of mass flow.-The unit of mass flow shall be the kilogram per second.

(Symbol : kg/s or kg. s-1)The kilogram per second is the mass delivered by the uniform discharge of a mass of one kilogram traversing the given cross-section in one second.

14. Unit of specific volume.-The unit of specific volume shall be the cubic metre per kilogram.

(Symbol : m3/kg)The cubic metre per kilogram is the specific volume of a homogeneous body having a volume of one cubic metre and a mass of one kilogram.

Part III – DERIVED UNITS IN RELATION TO HEAT

1.

Unit of entropy.-The unit of entropy shall be the joule per kelvin.(Symbol : J /K)The joule per kelvin is the increase of entropy of a system receiving a quantity of heat equal to one joule at the constant thermodynamic temperature of one kelvin, provided that no irreversible change takes place in the system.

2.

Unit of specific entropy.-The unit of specific entropy shall be the joule per kilogram kelvin.[Symbol : J/(kg.K)]The joule per kilogram kelvin is the specific entropy of a system of homogeneous mass of one kilogram receiving a quantity of heat equal to one joule at the constant thermodynamic temperature of one kelvin, provided that no irreversible change takes place in the system.

3.

Unit of heat capacity.-The unit of heat capacity shall be the joule per kelvin.(Symbol : J/K)The joule per kelvin is the heat capacity of a homogeneous body in which a quantity of heat equal to one joule produces an increase of one kelvin in the thermodynamic temperature.

4.

Unit of specific heat capacity.-The unit of specific heat capacity shall be the joule per kilogram kelvin.[Symbol : J/(kg.K)]The joule per kilogram kelvin is the specific heat capacity of a homogeneous body having a mass of one kilogram in which quantity of heat equal to one joule produces an increase of one kelvin in the thermodynamic temperature.

5.

Unit of latent heat.-The unit of latent heat shall be the joule per kilogram.(Symbol : J/kg)The joule per kilogram is the specific energy of a system of homogeneous mass of one kilogram having the internal energy of one joule.

6.

Unit of specific energy.-The unit of specific energy shall be the joule per kilogram[Symbol : J/kg]The joule per kilogram is the heat exchanged by one kg of substance to change from one phase to another at the temperature of its changing phase.

7.

Unit of thermal conductivity.-The unit of thermal conductivity shall be the watt per metre kelvin.[Symbol: W/(m.K)]The watt per metre kelvin is the thermal conductivity of a homogeneous body in which a difference of one kelvin in the thermodynamic temperature produces a radiant flux of one watt between two parallel planes, each having an area of one square metre, placed one metre apart.

1 W/m.K = 1w/m2

1k/1m

8.

Unit of energy density.-The unit of energy density shall be the joule per cubic metre.(Symbol : J/m3)The joule per cubic metre is the energy density of a system of homogeneous mass of volume one cubic metre and having the radiant energy of one joule.

9.

Unit of heat flux density.-The unit of heat flux density shall be the watt per square metre.(Symbol : W/m2)The watt per square metre is heat flux density of a surface of one square metre in area radiating out energy at the rate of one joule per second.

Part IV – Derived Units In Relation To Electricity And Magnetism

1.

Unit of quantity of electricity and electric charge.-The unit of quantity of electricity and electric charge shall be the coulomb.(Symbol : C)The coulomb is the quantity of electricity carried in one second by a current of one ampere.

1C. =1A.1s

2. Unit of electric charge density.-The unit of electric charge density shall be the coulomb per cubic metre.

(Symbol : C/m3)The coulomb per cubic metre is the electric charge density of a homogeneous mass or system of volume one cubic metre and having a charge of one coulomb.

3.

Unit of electric flux density.-The unit of electric flux density shall be the coulomb per square metre.(Symbol : C/m2)The coulomb per square metre is the electric flux density when a condenser, having plates of infinite area/size, parallel to each other, is charged, in vacuum, with a quantity of electricity equal to one coulomb per one square metre of area of the plates.

4.

Unit of electric tension, electric potential and electromotive force.-The unit of electric tension, electric potential and electromotive force shall be the volt.((Symbol : V)The volt is the potential difference between two points of a conducting wire carrying a constant current of one ampere, when the power dissipated between these points is equal to one watt.

1V = 1W

1A

5.

Unit of electric field strength.-The unit of electric field strength shall be the volt per metre.(Symbol : V/m)The volt per metre is the electric field strength of an electric field which produces a forte equal to one newton in a body charged with a quantity of electricity equal to one coulomb.

1V = 1N

1m 1C

6.

Unit of electric resistance.-The unit of electric resistance shall be the ohm(Symbol: □The ohm is the electric resistance'between two points of a conductor when a constant potential difference of one volt, applied to these points, produces in the conductor a current of one ampere, the conductor not being the seat of any electromotive force.

1□= 1V

1A

7.

Unit of conductance.-The unit of conductance shall be the siemens.(Symbol : S)The siemens is the conductance of a conductor having a resistance of one ohm.

1S.

=1/□=1□-1

8.

Unit of capacitance.-The unit of capacitance shall be the farad(Symbol : F)The farad is the capacitance between the conductors of a capacitor across which there appears a potential difference of one volt when it is charged by a quantity of electricity of one coulomb.

1F = 1C =1C/1V

1V

9.

Unit of permittivity.-The unit of permittivity shall be the farad per metre.(Symbol : F/m)The farad per metre is the permittivity of the medium which gives a capacitance of one farad per square metre of area of two parallel plates separated by a distance of one metre.

10.

Unit of inductance.-The unit of inductance shall be the henry.(Symbol : H)The henry is the inductance of a closed circuit in which an electromotive force of one volt is produced when the electric current in the circuit varies uniformly at the rate of one ampere per second.

1H = V =1VsA-1

A/s

11.

Unit of permeability.-The unit of permeability shall be the henry per metre.(Symbol : H/m)The henry per metre is the permeability of a material surrounded by a single turn 'of flat sheet conductor including an area of one square metre and length one metre which gives an inductance of one henry.

12.

Unit of magnetic flux and flux of magnetic induction.-The unit of magnetic flux and flux of magnetic induction shall be the weber.(Symbol : Wb)The weber is the magnetic flux which, linking a circuit of one turn, would produce in it an electromotive force of one volt if it were reduced to zero at a uniform rate in one second.

1. Wb/s=1 V,i.e.,1 Wb=1 Vs

13.

Unit of magnetic induction and magnetic flux density.-The unit of magnetic induction and magnetic flux density shall be the tesla.(Symbol : T)The tesla is the uniform magnetic induction which, distributed evenly over a surface of one square metre, produces a total magnetic flux of one weber while passing over the surface.

1T = 1Wb 1Wb.m-2

1m2

14.

Unit of magnetic field strength.-The unit of magnetic field strength shall be the ampere per metre(Symbol : A/m or A.m-1)The ampere per metre is the magnetic field strength produced in vacuum along the surface of a circular cylinder with a circumference of one metre, by a current of intensity of one ampere, maintained in a straight conductor of infinite length, of negligible circular cross-section, which forms the axis of the said cylinder.

15.

Unit of current density.-The unit of current density shall be ampere per square metre.(Symbol : A/m2)The ampere per square meter is the current density in a linear conductor when a current of intensity one ampere flows uniformly through a cross-section of the conductor equal to one square metre, perpendicular to the direction of flow of the current.

Part V – Derived Units In Relation To Electromagnetic Radiation And Light

1.

Unit of radiant intensity.-The unit of radiant intensity shall be the watt per steradian.(Symbol: W/sr)The watt per steradian is the radiant intensity of a point source uniformly emitting a radiant flux of one watt within a solid angle of one steradian.

2.

Unit of irradiance.-The unit of irradiance shall be the watt per square metre.(Symbol: W/m2)The watt per square metre is the irradiance produced by a radiant flux of one watt, distributed uniformly over an element having a surface of one square metre.[See also (1) above]

3.

Unit of radiance.-The unit of radiance shall be the watt per square metre steradian.(Symbol : W/m2. sr)The watt per square metre steradian is the radiance of a source radiating one watt per steradian per square metre of projected area.

4.

Unit of luminance.-The unit of luminance shall be the candela per square metre.(Symbol : Cd/m2)The candela per square metre is the luminance perpendicular to the plane surface of one square metre of a source, the luminous intensity of which perpendicular to this source, is one candela.

5.

Unit of luminous flux.-The unit of luminous flux shall be the lumen.(Symbol: lm)The lumen is the luminous flux emitted in a solid angle of one steradian by a uniform point source having a luminous intensity of one candela.lm =1 Cd. sr

6.

Unit of illuminanceThe unit of illuminance shall be the lux(Symbol : lx)The lux is the illuminance produced by a luminous flux of one lumen, uniformly distributed over a surface of area one square metre.

1 lx = 1 1 lm 1 lm.m-2

1m2

Part VI – Derived Unit In Relation To Ionising Radiations

1.

Unit of activity (radioactivity).-The unit of activity (of a radioactive source) shall be the becquerel(Symbol : Bq)The becquerel is the activity of a radioactive source in which one transformation or one transition takes place in one second.

1Bq.

=1/.1.s=1s-1

2.

Unit of absorbed dose.-The unit of absorbed dose shall be gray which is equivalent to one joule per kilogram(Symbol : Gy)The gray is the dose absorbed in an element of substance of mass one kilogram to which an energy of one joule is communicated by an ionising radiation, having a constant density of radiant flux.

1Gy.

=1J/1 kg = 1J.kg-1

Part VII – Derived Units In Relation To Physical Chemistry And Molecular Physics

1.

Unit of concentration (of amount of substance).-The unit of concentration (of amount of substance) shall be the mole per cubic metre.(Symbol : mol/m3)The mole per cubic metre is the concentration of a homogeneous solution having a total volume of one cubic metre and containing one mole of the given substance.

2.

Unit of molar energy.-The unit of molar energy shall be the joule per mole.(Symbol : J/mol)The joule per mole is the molar energy of one mole of substance having the energy of one joule.

3.

Unit of molar entropy.-The unit of molar entropy shall be joule per mole kelvin.(Symbol : J/mol K)The joule per mole kelvin is the molar entropy of a system of homogeneous mass having a substance equal to one mole receiving a quantity of heat equal to one joule at the constant thermodynamic temperature of one kelvin provided that no irreversible change takes place in the system.

4. Unit of molar heat capacity.-The unit of molar heat capacity shall be the joule per mole kelvin.

(Symbol : J/mol.K)The joule per mode kelvin is the molar heat capacity of a homogeneous body having an amount of substance equal to one mole, in which a quantity of heat equal to one joule produces an increase of one kelvin in the thermodynamic temperature.

III

Names, Magnitudes And Symbols Of Si Prefixes And Principles Of Use Of Si Prefixes(See rule 6)

1. Name, magnitudes and symbols of SI prefixes. - The names of prefixes, their magnitudes and symbols shall be as given in Table I

TABLEIName of prefixes, their magnitudes and symbols

Name of prefix	Magnitude of prefix	Symbol of prefix
exa	1018	E
peta	1015	P
tera	1012	T
giga	109	G
mega	106	M
kilo	103	k
hecta	102	h
Deca	101	da
deci	10-1	d
centi	10-2	c
mili	10-3	m
micro	10-6	µ
nano	10-9	n
pico	10-12	p
femto	10-15	f
atto	10-18	a

Explanation.-The unit of length is metre with symbol m : after adding a prefix 'c' for centi we get "cm" as new unit symbol. This can be raised to a positive exponent 3 to give the unit of volume. Similarly this can be combined with another unit say 'kg' and by giving it negative exponent 3 to indicate density in kg per cm3

Kg/cm3=	kg = 106kg/m3
10-6m3	

Similarly g/cm3= 1000 kg/m3

2. Symbol how to be combined with units.-(a) The symbol of the prefix shall be placed before the unit symbol without any intermediary space or dot; (b) The combination shall form the symbol of the multiple and sub-multiple of the unit; (c) The symbol for the prefix shall be considered to be combined with the symbol of the unit to which it is directly linked together, forming a

new unit symbol, which can be combined with other unit symbols to form composite unit symbols.

3. Errors how to be avoided.-To avoid errors in calculations, all quantities shall be expressed in SI units, and powers of 10 shall be used.

4. Exponents.-An exponent affixed to a symbol containing a prefix indicates that the multiple or sub-multiple of the unit is raised to the power expressed by the exponent.

Illustration:

1cm. =102m gives 1cm3=10-6m3 and 1cm-1 =102m-1

5. Compound units how to be formed.-Only one prefix shall be used in forming the multiples of a compound unit, and compound prefixes shall not be used.

Illustration:Write nm (nano metre), instead of m m.

6. Use of prefixes with unit of mass.-Notwithstanding that the base unit of mass contains a prefix, names of decimal multiples and sub-multiples of the unit of mass shall be formed by attaching prefixes to the word gram.

IllustrationWrite milligram (mg) but not microkilogram (µkg)

7. Printing: (1) Symbols of units,

(a)shall be printed in roman (upright) type irrespective of the type used in the rest of the text;(b)shall remain unaltered in the plural;(c)shall be written, without a final full stop (period) unless the context otherwise requires; and(d)shall be placed after the complete numerical value in the expression for a quantity, leaving a space between the numerical value and the unit.(2)The symbols for units of weight or measure shall be printed in lower case letters except that the first letter shall be printed in upper case when the name of the unit is derived from a proper name.Illustration:m-metreA-ampereWb-weber

8. Multiplication of units.-(1) When a compound unit is formed by multiplication of twoor more units, the multiplication may be indicated in one of the following ways;

M. N, N. m, Nm(2)In using a symbol of a unit of weight or measure which coincides with the symbol for a prefix, special care shall be taken to avoid confusion.Illustration:The unit "newton metre" shall be written Nm or m.N to avoid confusion with mN, the millinewton

9. Division of units.-(l) When a compound unit is formed by dividing one unit by another the division shall he indicated in one of the following ways:

m/s or by writing the product of m and s-1 as ms-1(2)The letter p shall not be used to denote division.Illustration:Do not write kmph, write km/h or km.h-1(3)In no case shall more than one solidus (oblique stroke) on the same line be included in such a combination unless parentheses are inserted to avoid ambiguity.Illustration:Write m/s2 or m.s-2 but not m/s/s(4)In complicated cases, negative powers or parantheses shall be used.Illustration:Write m.kg/(s3.A) or m.kg.s-3.A-1 but not m.kg/s3/A:

10. Expression of results.-(1) The appropriate integral multiple and sub-multiple to which a unit is to be expressed shall be selected in such a manner that the numerical value to be expressed is between 0.1 and 1000.

Illustration:1.2x 10"N may be written as 12 kN0.00394mmay be written as 3.94 mm

1401. Pa may be written as 1.401 kPa

3.1x 10 8s may be written as 31 ns(2)In a table of values for the same quantity or in a discussion of such values within a given context the same integral multiple or sub-multiple of a unit may be used for all items, even when some of the numerical values may be outside the range of 0.1 to 1000.(3)For the purpose of expression of dimensions in mechanical engineering drawings, only the millimetre shall be used.

11. Expression of numbers.-(1) To express numbers in connection with units of weights and measures, the dot shall be used to separate the integral part of numbers from the decimal part.

(2)Numbers shall be divided in groups of three starting from the decimal point in order to facilitate reading and neither dots nor commas, shall be inserted in the space between such group of numbers.Illustration:Write 3 211468.022 82not 3.211.468.022.82or 3,211,468.022.82

IV

Units Permitted To Be Used With Base, Supplementary Or Derived Units(See rule 7)

1. Permitted units of time.-(1) The permitted units in relation to time shall be as follows, namely,

(a)(i)the minute, equal to 60 seconds (symbol : min),(ii)the hour, equal to 3600 seconds or 60 minutes (symbol : h), and(iii)the day, equal to 86 400 seconds or 24 hours (symbol : d)(b)The week, month and year shall correspond to the Saka Calendar or the Gregorian Calendar.

2. Permitted units of plane angle.-The permitted units in relation to plane angle shall be as follows, namely,

(i)the degree, equal to 7c / 180 radian (symbol : °),(ii)The minute, equal to 7t/10800 radian or (1 /60)° (symbol : '), and(iii)the second equal to it/648000 radian or (1 /60)', (symbol : ")

3. Permitted unit of volume.-(1) The permitted unit of volume shall be the litre (symbol :1). The litre shall be equal to one thousandth part of the cubic metre.

11.

=1dm3 = 10-3m3(2)The litre shall not be used for work involving precise measurements.

4. Permitted unit of mass.-(1) The permitted unit of mass shall be the tonne.

(Symbol: t)The.tonne is equal to 1000 kilograms.(2)Only the prefixes "kilo" "mega", "giga" and "tera" specified in Schedule III may be used with the tonne.

V

Special Units And Their Symbols(See rule 8)

1. Special unit of energy.-The special unit of energy acquired by an electron shall be the electron volt.

(Symbol : eV)The electron volt is the energy acquired by an electron in passing through a potential difference of one volt in vacuum.

1eV.

=1.60217733x10-19J

2. Special unit of atomic mass.-The special unit of mass of an atom shall be the unified atomic mass unit.

(Symbol : u)The unified atomic mass unit is equal to the fraction 1/12 of the mass of an atom of the nucleus 12C

1u. =1.660540 2x10-27kg.

3. Special units of stellar distance.-(1) The first special unit of stellar distance shall be the astronomical unit.

(Symbol : AU)The astronomical unit of distance is the length of the radius of the unperturbed circular orbit of a body of negligible mass moving round the Sun with a sidereal angular velocity of 0.017202098950 radian per day of 86400 ephermeris seconds.IAU=14960x106mNote.-The symbol for stellar distance is not internationally uniform, for example the symbol used for stellar distance is UA in France, AU in England and AE in Germany.(2)The second special unit of stellar distance shall be the persec (symbol: pc)The persec is the distance at which one astronomical unit substands an angle of one second of arc.

1. pc=206 265 AU

= 30 857 x 1012m.

VI

Temporarily Accepted Units(See rule 9)

1. Unit of nautical distance.-The unit of distance for use in marine and aerial navigation shall be the nautical mile. The nautical mile is equal to a distance of 1852 metres.

2. Unit of nautical velocity.-The unit of velocity for use in marine and aerial navigations shall be the knot. The knot is the velocity equal to one nautical mile per hour.

1. knot = (1852/3600) m/s, i.e., 0.514444 m/s.

3. Unit of wavelength of light.-(1) The unit of wavelength of light shall be the angstrom.

(Symbol : A)The angstrom is equal to 0.1 nanometre.

1A.

=0.1nm=10-10m

4. Units of land measurement.-(1) The first unit for measurement of land area shall be the "are"

(Symbol : a)The "are" is the area of a square with sides of length 10 metres.Ia=1dam2=102m2(2)The second unit for measurement of land area shall be the hectare. (Symbol : ha)The hectare is the area of a square with sides of length 100 metres.I ha = 1hm2=104m2(3)The prefixes specified in Schedule III shall not be used with the "are" or hectare.

5. Unit of nuclear cross-section.-The unit of nuclear cross-section shall be the barn.

(Symbol : b)The barn is the nuclear cross-section area equal to 100 square femtometres.

1. b =10-28 m2

6. Unit of pressure of fluid.-The unit of pressure of fluid shall be the bar (Symbol: bar)

The bar shall be equal to 100 000 pascals.

7. Unit of standard atmosphere.-The unit of standard atmosphere shall be 101325 pascals.

The standard atmosphere is the pressure exerted by air at mean sea level under the standard conditions specified by the General Conference on Weights and Measures.

8. Special unit of acceleration due to gravity.-The special unit of acceleration due to gravity for use in geodesey and geophysics shall be the gal (Symbol : Gal).

The gal is equal to 1 / 100 metre per second square.

9. Unit of activity of radio-nuclides.-The unit of activity of radionuclides shall be the curie.

(Symbol : Ci)The curie is the quantity of any radioactive nuclide in which the number of disintegrations per second is3.7x1010or

1. Ci = 3.7 x 1010 Bq

10. Unit of exposure dose.-The unit of exposure dose shall be the rontgen.

(Symbol : R)The rontgen is the exposure dose of an ionising radiation which can produce in a quantity of air having a mass of one kilogram, ions of the same sign carrying a total charge 2.58 x 10-4 coulomb, the density of energy flux being the same throughout the quantity of air taken.R=2.58 x 10-4C/kg

11. Unit of velocity.-The unit of velocity will be kilometre per hour.

(Symbol : km/h)The kilometre per hour is the velocity of a body in motion which when set in a uniform motion, traverses a distance of one kilometre in one hour.

12. Unit of mass of special value.-The unit of mass of special value shall be the carat.

(Symbol : c)The carat is equal to five thousandth part of the kilogram. It shall be used for commercial transactions in diamonds, pearls and precious stones.

1c.

=200 mg

13. Unit of mass for special use.-The unit of mass for special use shall be the quintal (symbol : q)

The quintal is equal to 100 kilograms. The quintal may be used in large commercial transactions in food grains, farm produce and other consumer commodities.

VII

C.G.S.Units With Special Names(See rule 10)

Name of unit	Symbol	Value in terms of base, supplementary or derived units	
(1)erg	erg	1 erg= 10-7J	
(2)dyne	dyn	1 dyn= 10-5N	
(3)poise	p	1 P =1 dyn.s/cm2= 0.1 Pa.s	
(4)stokes	st	1 st= 1cm2/s = 10-4m2/s	
(5)gauss	Gs, G	1 Gs=10-4T	
(6)Oersted	Oe	1 Oe =	1000 A
4□	m		

(7)maxwell	Mx	1 Mx= 10-8Wb
(8)stilb	sb	Sb =1 cd/cm2= 104cd/m2
(9)phot	ph	1 ph= 1041x

VIII

Units Outside The International System(See rule 10)

Name of unit	Value in terms of base, supplementary or derived units	
(1)fermi	1fermi = 1m = 10-15m	
(2)torr	1torr=	101 325 Pa
760		
(3)Kilogram-force(kgf)	1 kgf= 9.806 65 N	
(4)Calorie (cal)*	1 ca= 4.186 8 J	
(5)Micron(μ)	1 μ -1 μm = 10-6m	
(6)X unit**	1 X unit = 1.002 x 10-4nm approximately	
(7)stere (st)***	1 st= 1m3	
(8)gamma (y)	1Y =1 nT = 10-9T	
(9)Y	1Y =1μg= 10-9kg	
(10)□	1 □= 1 μl = 10-61 = 10-9m3	

*This value is that of that `IT' calorie (5th Internaional Conference on Properties of Steam, London, 1956).**This special unt was employed to express wavelenghts of X-rays***This special unit was used to measure firewoiod.

IX

Important Physical Constants(See rule 11)

Quantity	Symbol	Value	Units	Relative uncertainty (ppm)
GENERAL CONSTANTSUniversal constants				
Speed of light in vacuum	c	299792.458	ms-1	(exact)
Permeability of vacuum	μo	4□x 10-7	NA-2	(exact)
=12,566370614..	10-7NA-2			
Permittivity of vacuum	Eo	1μoc2	10-12Fm-1	(exact)
=8.854187817				
Newtonian constant of gravitation	G	6.67259(85)	10-11m3kg-1s-2	128
Planck constant	h	6.6260755(40)	10-34Js	0.60
in electron volts h/{e}		4.1356692(12)	10-15eVs	0.30

h/2□	h	1.05457266(63)	10-34Js	0.60
In electron volts, h/{e}		6.5821220(20)	10-16eVs	0.30
Planck mass, (hc/G)1/2	mp	2.17671(14)	10-8kg	64
Planck length, h/mpc = (hG/C3)1/2	1p	1.61605(10)	10-33m	64
Planck time 1p/c = (hG/c5)1/2	tp	5.39056(34)	10-44s	64
ELECTROMAGNETIC CONSTANTS				
Elementary charge	e	1.60217733(49)	10-19C	0.30
	e/h	2.41798836(72)	1014AJ-1	0.30
Magnetic Flux quantum, h/2e	□o	2.06783461(61)	10-15Wb	0.30
Josephoson frequency-voltage ratio	2e/h	4.8359767(14)	1014HzV-1	0.30
Quantized Hall conductance	e2/h	3.87404614(17)	10-5S	0.045
Quantized Hall resistance, h/e2= ½ (muo c/L)	Rh	25812.8056(12)	□	0.045
Bohr magneton, eh/2me	µB	9.2740154(31)	10-24JT-1	0.34
In electron volts, µB/{e}		5.78838263(52)	10-5eVT-1	0.089
In hertz, µB/h		1.39962418(42)	10101HzT-1	0.30
In wavenumbers, µB/hc		46.686437(14)	m-1T-1	0.30
in kelvins, µB/hc		0.6717099(57)	KT-1	8.5
Nuclear magneton, eh/2m	µN	5.0507866(17)	10-27JT-1	0.34
In electron volts, µN/{e}		3.15245166(28)	10-8eVT-1	0.089
In hertz, µN/h		7.622914(23)	MHzT-1	0.30
In wavenumbers, µN/hc		2.54262281(77)	10-2m-1T-1	0.30
In kelvins, µN/k		3.658246(31)	10-4KT-1	8.5
ATOMIC CONSTANTS				
Fine structure constant, ½ µoce2/h	□	7.29735308(3)	10-3	0.045
Inverse fine structure constant	□-1	137.0359895(61)		0.045
Rydberg constant,1/2 mec□2/h	R□	10973731.534(13)	m-1	0.0012
In hertz, R□c		3.2898419499(39)	1015Hz	0.0012
In joules, R□hc		2.1798741(13)	10-18J	0.60
In eV, R□hc/{e}		13.6056981(40)	eV	0.30
Bohr radius,□/4□R□	□o	0.529177249(24)	10-10m	0.045
Hartree energy,e2/4 o□o= 2R□hc	Eh	4.3597482(26)	10-18J	0.60
In eV, Eh/{e}		27.2113961(81)	eV	0.30
Quantum of circulation	h/2me	3.63694807(33)	10-4m2s-1	0.089
	h/me	7.27389614(65)	10-4m2s-1	0.089
ELECTRON				

Electron mass	me	9.1093897(54)	10-31kg	0.59
		5.48579903(13)	10-4u	0.023
In electron volts, mec2/{e}		0.51099906(15)	MeV	0.30
Electron-muon mass ratio	me/mμ	4.83633218(71)	10-3	0.15
Electron proton mass ratio	me/mp	5.44617013(11)	10-4	0.020
Electron deuteron mass ratio	me/md	2.72443707(6)	10-4	0.020
Electron-□-particle mass ratio	me/m□	1.37093354(3)	10-4	0.021
Electron specific charge	-e/me	-1.75881962(53)	1011Ckg-1	0.030
Electron molar mass	M(e). Me	5.48579903(13)	10-7kg/mol	0.023
Compton wavelength, h/mec	□C	2.42631058(22)	10-12m	0.089
□C/2□= □ao= □2/4□R□	□C	3.86159323(35)	10-13m	0.089
Classical electron radius □2ao	re	2.81794092(38)	10-15m	0.13
Thomson cross section (8□/3)r2e	□e	0.66524616(18)	10-23m2	0.27
Electron magnetic moment	μe	928.47701(31)	10-26JT-1	0.34
In Bohr magnetons	μe/μB	1.001159652193(10)		1 x 10-5
In nuclear magnetons	μe/μN	1838.282000(37)		0.020
Electron magnetic moment anomaly, μe/μB-1	□e	1.159652193(10)	10-3	0.0086
Electron g-factor, 2(1 + □)	ge	2.002319304386(20)		1 x 10-5
Electron-muon magnetic moment ratio	μe/μμ	206.766967(30)		0.15
Electron-proton magnetic moment ratio	μe/μp	658.2106881(66)		0.010
Muon mass	μμ	1.8835327(11)	10-28kg	0.61
		0.113428913(17)	u	0.15
In electron volts	mμc2{e}	105.658389(34)	MeV	0.32
Muon-electron mass ratio	mμ/me	206/768262(30)		0.15
Muon molar mass	M(μ), Mμ	1.13428913(17)	10-4kg/mol	0.15
Muon magnetic moment	μμ	4.4904514(15)	10-26JT-1	0.33
In Bohr magnetons	μμ/μB	4.84197097(71)	10-3	0.15
In nuclear magnetons	μμ/μN	8.8905981(13)		0.15
Muon magneticmoment anomaly				
[μμ/(eh/2mμ)]-1	□μ	1.1659230(84)	10-3	7.2
Muon g-factor, 2(1 + □μ)	gμ	2.002331846(17)		0.0084
Muon-proton magnetic moment ratio	μμ/μp	3.18334547(47)		015
PROTON				

Proton mass	mp	1.6726231(10)	10-27kg	0.59
		1.007276470(12)	u	0.012
In electron volts, mpC2/(e)		938.27231(28)	MeV	0.30
Proton-electron mass ratio	mp/me	1836.152701(37)		0.020
Proton-muon mass ratio	mp/mµ	8.8802444(13)		
Proton specific charge	e/mp	9.5788309(29)	107Ckg-1	0.30
Proton molar mass	M(p), Mp	1.007276470(12)	10-3kg/mol	0.012
Proton Compton wavelength, h/mpc	□Cp	1.32141002(12)	10-15m	0.089
□cp/2□	□Cp	2.10308937(19)	10-16m	0.089
Proton magnetic moment	µp	1.41060761(47	10-26JT-1	0.34
In Bohr magnetons	µp/µB	1.521032202(15)	10-3	0.010
In nuclear magnetons	µp/µN	2.792847386(63)		0.023
Diamagneticshielding correction for portions in pure water, spherical sample, 25 C, 1-µ'p/µ/p	□H2O	25.689(15)	10-6	
Shielded proton moment (H2O sph., 25 C)	µ'p	1.41057138(47)	10-26JT-1	0.34
In Bohr magnetons	µ'p/µB	1.520993129(17)	10-3	0.011
In nuclear magnetons	µ'p/µN	2.792775642(64)		0.023
Proton gyromagnetic ratio	Ýp	26752.2128(81)	104s-1T-1	0.30
	Ýp/2□	42.577469(13)	MHzT-1	0.30
Uncorrected(H2O sph. 25C)	Ýp	26751.5255(81)	104s-1T-1	0.30
	Ýp/2□	42.576375(13)	MHzT-1	0.30
Neutron mass	mn	1.6749286(10)	10-27kg	0.59
		1.008664904(14)	u	0.014
In electron volts, mnc2/{e}		939.56563(28)	MeV	0.30
Neutron-eletron mass ratio	mn/me	1838.683662(40)		0.022
Neutron-proton mass ratio	mn/mp	1.001378404(9)		0.009
Neutron molar mass	M(n), Mn	1.008664904(14)	10-3kg/mol	0.014
Neutron Compton wavelength, h/mnc	□c,n	1.31959110(12)	10-15m	0.089
□cn/2□	□c,n	2.10019445(19)	10-16m	0.089
Neutron magnetic moment*	µn	0.96623707(40)	10-26JT-1	0.41
In Bohr magnetons	µn/µB	1.04187563(25)	10-3	0.24
In nuclear magnetons	µn/µN	1.91304275(45)		0.24
	µn/µp	0.68497934(16)		0.24

Neutron proton magnetic moment ratio				
DEUTERON				
Deuteron mass	md	3.3435860(20)	10-27kg	0.59
		2.013553214(24)	u	0.012
In electron volts, mdC2/{e}		1875.61339(57)	MeV	0.30
Deuteron-electro mass ratio	md/me	3670.483014(75)		0.020
Deuteron-proton mass ratio	md/mp	1.999007496(6)		0.003
Deuteron molar mass	M(d), Md	2.013553214(24)	10-3kg/mol	0.012
Deuteron magnetic moment	µd	0.43307375(15)	10-26JT-1	0.34
In Bohr magnetons	µd/µB	0.4669754479(91)	10-3	0.019
in nuclear magnetons	µd/µN	0.857438230(24)		0.028
Deuteron-electron magnetic moment ratio	µd/µe	0.4664345460(91)		0.019
Deuteron-proton magnetic moment ratio	md/mp	0.3070122035(51)		0.017
PHYSICO-CHEMICAL CONSTANTS				
Avogadro constant	NA,L	6.0221367(36)	1023mol-1	0.59
Atomic mass constant mu=1/12m(12C)	mu	1.6605402(10)	10-27kg	0.59
In electron volts, muc2/{e}		931.49432(28)	MeV	0.30
Faraday constant	F	96485.309(29)	Cmol-1	0.30
Molar Planck constant	NAh	3.99031323(36)	10-10Jsmol-1	0.089
	NAhc	0.11962658(11)	Jm mol-1	0.089
Molar gas constant	R	8.314510(70)	Jmol-1K-1	8.4
Boltzmann constant, R/NA	k	1.380658(12)	10-23JK-1	8.5
In electron volts, k/{e}		8.617385(73)	10-5eVK-1	8.4
In hertz, k/h		2.083674(18)	1010HzK-1	8.4
In wavenumbers, k/hc		69.50387(59)	m-1k-1	8.4
Molar volume (ideal gas), RT/pT =273.15 K, p=101 325 Pa	Vm	22.41410(19)	L/mol	8.4
Loschmidt constant, NA/Vm	no	2.686763(23)	1025m-3	8.5
T =273.15K, p = 100kPa	Vm	22.71108(19)	L/mol	8.4
Sackur Tetrode constant (absolute entropy constant)** 5/2 + In(2□mukT1/h2)3/2kT1/po}				
T1 =1K, Po = 100 kPa	So/R	-1.151693(21)		18

P□= 101 325Pa		-1.164856(21)		18
Stefan-Boltzmann constant, (□2/60)k4/h3c2	□	5.67051(19)	10-8Wm-2k-4	34
First radiation constant, 2□hc2	C1	3.7417749(22)	10-16Wm2	0.60
Second radiation constant, hc/k	C2	0.01438769(12)	mK	8.4
Wien displacement law constant,	b	2.897756(24)	10-3mk	8.4

B =□maxT = c2/4.96511423 .

*The scalar magnitude of the neutron moment is listed here. The neutron magnetic dipoles directed oppositely to that of the proton, and corresponds to the dipole associated with a spinning negative charge distribution. The vector sum, μd = μp + μ,,, is approximately satisfied.**The entropy of an ideal monatomic gas of relative atomic weight Ar is given by S = So + 3/2R1nAr - Rln(p/po) + 3/2 Rln (T/K).

X

(See rule 12)The following coefficients shall be used for the purpose of these rules:

1. Alcoholic strengths. (a) The "alcoholic strength by volume" of a mixture of water and alcohol is the ratio of the volume of alcohol, measured at 20°C, contained in the mixture to the total volume of the mixture, measured at the same temperature. The symbol is "% vol".

(b)The "alcoholic strength by mass" of a mixture of water and alcohol is the ratio of the mass of alcohol contained in the mixture to the total mass of the mixture. The symbol is "% mass".For the purpose of the inter-relation between these two strengths and between the density of acquous solution of alcohol, the International recommendation No. 22 on Alcoholometry, together with the International Alcoholometric Tables, shall be used.

2. Hardness numbers for materials-

(a)Brinell Hardness Number.-A number related to the size of the permanent impression made by a ball indenter of specified size, pressed into the surface of the material under a specified load. The surface area of the impression is determined from the average measured diameter of the rim of the impression and from the ball diameter. In reporting Brinell hardness number, the International Recommendation No. 9, on verification and calibration of Brinell Hardness Standardised Blocks, shall be used.(b)Diamond pyramid or Vickers Hardness Number.-A number obtained by dividing the load in kilograms applied to a square-based pyramidal diamond indenter having included face angles of 136° by the surface area of the impression calculated from the measured diagonal of the impression. In reporting diamond pyramid hardness, the International Recommendation No. 10 on verification and calibration of Vickers Hardness Standardised Blocks, shall be used.(c)Rockwell Hardness Number.-A number derived from net increase in depth of impression as the load on all indenter is increased from a fixed minimum load. In reporting Rockwell hardness number on Rockwell B scale, the International Recommendation No. 11 on verification and calibration of

Rockwell B Hardness Standardised Blocks, shall be used.Similarly, in reporting Rockwell hardness number on Rockwell C scale, the International Recommendation No. 12 on verification and calibration of Rockwell C Harness Standardised Block shall be used.

3. For the purpose of determining the sugar content present in the sugar solutions either of the two following coefficients may be used. Degree Brix or sugar degree (°S)

(a)Degree brix is the percentage of sucrose present by mass in the sugar solution. In reporting the degree brix, Indian Standard Specification for brix hydrometres: (IS : 7324-1974) shall be used, till such time, the Directorate of Legal Metrology or the International Organisation of Legal Metrology prepares such document.(b)Sugar degree on the international sugar scale is defined as follows:The 100°S point of the International Sugar Scale is fixed by the optical rotation ".t" undergone by the polarized light of the green line of the mercury isotope 198 (μ-546.2271 nm in vacuum), when passing through a 200.00 mm length of sucrose solution in pure water, kept at a temperature of 20.00°C, and containing 26.0160 g, weighed in a vacuum of pure sucrose per 100.00 cm3 of solution "normal" sugar solution.A mass of 26.0160 g of sucrose corresponds to 26.00 g when this sucrose is weighed in air by means of weights with a density of 8000 kg/m3 in air, at a standard pressure of 101325 pascal, at a temperature of 20°C and a relative humidity of 50%, the density of this air therefore being 1.2 kg/ m3.

4. Relative humidity.-It is the ratio of the actual vapour pressure of water vapours present in air at the temperature of measurement of the saturation vapour pressure over a plane liquid water surface at the same temperature. This is expressed as a pure number as percentage.

5. PH is the logarithm to the base 10 of the inverse of the hydrogen ion concentration in a dilute ionic solution.

Explanation.-A 0.04 molar hydrochloric acid solution will have hydrogen ion concentration of 10" mol and its ph value is 1.4. Similarly, 0.001 mol hydrochloric acid solution will have the hydrogen ion concentration of 103 mole and its ph value is 3.