A CRITICAL STUDY OF PHYSICAL UNITS

by

GLENN LYONAL RUCKER

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INTRODUCTION

Purpose of Thesis

The purpose of this thesis was to make a critical study of the more important units of physics, and to record the results in a form such that this information could be used as ready reference.

Incident to the above purpose it was found necessary to make the following investigations; viz. the status of agreement of authorities with respect to definitions of the physical magnitudes and also of their units; the names of these magnitudes and of their units; to produce a uniform, systematic scheme of conversion factors and to arrange the physical magnitudes in a logical sequence.

Method of Recording the Results

The results of the investigations were recorded in tabular form as shown in the following excerpt from the tables.

Magnitude	Force
Symbol	F
Defining Equation	F=Ma
Dimensional Formula	M L T^{-2}
F.P.S. Gravitational Unit	POUND-FORCE is the force required to sustain a mass of one pound in a vacuum.
C.G.S. Gravitational Unit	GRAM-FORCE is the force required to sustain a mass of one gram in a vacuum.
F.P.S. Absolute Unit	POUNDAL is that force which will give an acceleration of one foot per second per second to a mass of one pound.
C.G.S. Absolute Unit	DYNE is that force which will give an acceleration of one centimeter per second per second to a mass of one gram.
To change F.P.S. gravitational units to C.G.S.gravitational units	Multiply by 453.59
To change C.G.S. gravitational units to F.P.S. gravitational units	Multiply by 2.2×10^{-3}
To change F.P.S. absolute units to C.G.S. absolute units	Multiply by 13826
To change C.G.S. absolute units to F.P.S. absolute units	Multiply by 7.233×10^{-5}
To change F.P.S. gravitational units to F.P.S. absolute units	Multiply by 32.17
To change F.P.S. absolute units to F.P.S. gravitational units	Multiply by .03108
To change C.G.S. gravitational units to C.G.S. absolute units	Multiply by 980.7
To change C.G.S. absolute units to C.G.S. gravitational units	Multiply by 1.02×10^{-3}
Definition	FORCE is the cause which changes or tends to change the state of motion or state of stress of a body.

The magnitudes studied are recorded in a row across the top margin of the charts in logical sequence through mechanics, heat, electricity and light. The points with respect to which each magnitude has been studied are recorded in a vertical column down the left margin of each chart. The points are: name of magnitude, symbol, defining equation, definition, dimensional formula, C.G.S. absolute unit, C.G.S. gravitational unit, F.P.S. absolute unit, F.P.S. gravitational unit and conversion factors.

The ruling of the tables into rectangles, together with the outline along the left margin and the sequence of magnitudes along the top margin, make a coordinate scheme of reference possible viz. suppose the C.G.S. absolute unit of force is desired; find the word force in the index and the number of the page and the vertical column on which force is discussed. Turning to the page and the column indicated run down the column to the rectangle opposite C.G.S. absolute unit and find the definition of the dyne.

The blank rectangles in the tables, are quite as significant as those which contain written information in that they signify that there is no information on that particular point relative to the magnitude recorded at the top of the column.

In case certain important information does not fit well into the coordinate scheme of recording, or in case such information requires considerable space, it is given in the supplement to the tables designated by small numerals following the point in the tables to which the information is relative.

Discussion of Items Recorded in Left Margin of Tables

Authorities are agreed with respect to the names of the magnitudes with few exceptions.

No attempt has been made to solve the notation problem in physics. There is little or no agreement among authorities in this respect, therefore, in so far as possible, the first letter of the magnitude has been used making use of subscripts freely.

Excellent agreement, of course, exists with respect to the meaning of the defining equation.

The mathematical physicist has little or no need of a definition i.e. in language form, of a physical magnitude; his defining equations being adequate in this respect. There is, however, need of a clearly expressed definition for the elementary student. Many writers, apparently, avoid any attempt to formulate a definition of a physical magni-

tude. Others define certain magnitudes clearly, but avoid defining those that are difficult of definition. Diffusivity is a magnitude which is clearly defined in equation form, but which is not ordinarily defined in language form.

Great care has been exercised by the author in attempting to formulate definitions. Much clearness may be acquired in such attempts.

Dimensional formulae are indispensable in determining the nature of units, and of the conversion factors, and in checking the validity of any equation involving magnitudes having units. For these reasons dimensional formulae have been included in the tables in all cases in which they exist.

Absolute units and gravitational units in both the English, or F.P.S. system, and the Metric, or C.G.S. system are included since a knowledge of both systems is necessary in correlating physical data from different sources.

The conversion factors have been computed and recorded in the form of multipliers since, in this form, they may be used by adding their logarithms.

An attempt has been made to use the term "specific" in the sense of a numeric. This, however, has been found impossible in certain cases.

Certain units have received names viz. the dyne- centimeter has been named the "erg". Many units have not been named and in such cases the author has adopted a name com-

posed of the names of the units of the component parts. In many cases such names are quite long, never-the-less it seems advisable to attempt to name them.

Only fundamental units i.e. foot-pound-second and centimeter-gram-second units have been included in the tables; multiple and submultiple units being omitted for want of space.

Discussion of Units of Magnetism and Electricity

A system of units of electric and magnetic quantities requires, in addition to the fundamental quantities mass, length, and time, used in mechanics, a fourth fundamental quantity called in the magnetic system permeability and in the electric system the dielectric constant.

The force, exerted between two magnetic poles immersed in a medium, is dependent upon that inherent property of the medium which determines the ease with which magnetic lines of force may be established through it. The ability of a unit cube of a material to allow magnetic lines of force to act through it is termed the specific permeability of that material. The specific permeability of free space is taken as unity and the specific permeability of any other medium is compared to it as a standard. This ratio, the specific permeability of any medium to the specific permeability of free space is called the relative permeability,

or more commonly permeability. Permeability is symbolized by and is the fourth fundamental quantity appearing in the dimensional formulae of the magnetic and electromagnetic systems.

The force, exerted between two charges immersed in a medium, is dependent upon the inherent ability of the medium for conveying the influence of an electric charge through it. The ability of a unit cube of a material to function as a dielectric is called the specific inductive capacity or inductivity of that material. The inductivity of free space is taken as unity and the inductivity of any other medium is compared to it as a standard. This ratio, the inductivity of any medium to the inductivity of free space is called the dielectric constant of the medium. The dielectric constant is symbolized by K and is the fourth fundamental quantity appearing in the dimensional formulae of the electrostatic system.

The Legalization of Units and Systems of Units

It has been the custom of nations, throughout the history of science to formulate, legalize and adopt certain units and systems of units. The Reichsanstalt of Germany, the Bureau International des Poids et Mesures of France, the

Vienna Standards Commission of Austria and the Bureau of Standards of the United States, function in this capacity. The functions of these bureaus, commissions etc. are similar, that of the United States being: the custody of the standards, the comparison of certain practical standards with those of the Bureau, the construction of standards, the testing and calibration of standard measuring apparatus and the determination of physical constants. The constitution of the United States delegates to Congress the power to coin money, to regulate the value thereof, and of foreign coin and so fix the standards of weights and measures. Attempts have been made to standardize the units of science through the agency of the Bureau International. Such standardization would save much labor as may be shown by noting the relative advantages and disadvantages of the English and the Metric systems of units.

Conclusions

The coordinate scheme of reference facilitates the use of information concerning units.

Of the ninety-four units listed and studied, approximately thirty-six percent have received names other than those compounded from the units of the factors of the magnitudes in question.

The notation problem is, at present, far from a solution. A satisfactory notation possibly should be adopted by physicists and engineers of the various fields of engineering which are essentially applied physics. A uniform notation, of course, is less essential to professional physicists and engineers than to elementary students.

Of the ninety-four possibilities for English definitions of the magnitudes, approximately twenty per cent have no satisfactory definitions.

It is hoped that the ready reference form of the information concerning physical units will be valuable especially to elementary students.

ACKNOWLEDGMENTS

It is impossible to name all of the sources from which information for the data compiled in these tables has been

derived. Many general college physics texts were examined. Professor Everett's, "C.G.S. System of Units", and Professor Guthe's, "Definitions" were consulted freely. The Smithsonian Tables as well as the Landoldt and Börnstein tables were used as checks on the data.

The problem was directed by Professor E.V. Floyd and was the extension of a work which he had begun. To him the author is indebted for the suggestion of the problem, for his advice from time to time in methods of attack, and for his untiring and ever ready help when difficulties were encountered.

MECHANICS

Interpretation of Symbols

M . . . . . mass

L . . . . . length

T . . . . . time

A . . . . . area

K . . . . . constant of proportionality

b . . . . . breadth

h . . . . . height

V . . . . . volume

θ . . . . . plane angle

ψ . . . . . solid angle

r . . . . . radius

D . . . . . density

V_S . . . . . specific volume

g_S . . . . . specific gravity

D_X . . . . . density of the substance in question

D_S . . . . . density of standard

ω . . . . . angular velocity

v . . . . . velocity

a . . . . . linear acceleration

g . . . . . gravity

α . . . . . angular acceleration

F . . . . . force

w . . . . . weight

I . . . . . moment of inertia

Σ . . . . . the sum of all the increments

$\mathcal{T}$ . . . . . torque

M_o . . . . . linear momentum

M_a . . . . . angular momentum

M_M . . . . . moment of momentum

$\mathcal{I}$ . . . . . impulse

$\mathcal{I}_M$ . . . . . moment of impulse

W . . . . . work

$\overline{PE}$ . . . . . potential energy

$\overline{KE}$ . . . . . kinetic energy

P . . . . . power

p . . . . . pressure

S . . . . . intensity of stress

S_N . . . . . strain

m . . . . . modulus of elasticity

L_1 . . . . . initial length

L_2 . . . . . final length

V_1 . . . . . initial volume

V_2 . . . . . final volume

1	2	3
Magnitude	Mass(1)	Length	Time
Symbol	M	L	T
Defining Equation			
Dimensional Formula	M	L	T
F.P.S. Gravitational Unit			
C.G.S. Gravitational Unit			
F.P.S. Absolute Unit	POUND-MASS (avoirdupois) is .45359 of the mass of the standard kilogram explained in the introduction	FOOT is .3048 of the length of the standard meter explained in the preface.	SECOND is 1/86400 of the mean solar day. i.e. time of one rotation of the earth.
C.G.S. Absolute Unit	GRAM-MASS is .001 of the mass of the standard kilogram explained in the introduction	CENTIMETER is .01 of the length of the standard meter explained in the preface.	SECOND (Same as above)
To change F.P.S. gravitational units to C.G.S. gravitational units			
To change C.G.S. gravitational units to F.P.S. gravitational units			
To change F.P.S. absolute units to C.G.S. absolute units	Multiply by 453.59	Multiply by 30.48	
To change C.G.S. absolute units to F.P.S. absolute units	Multiply by 2.205×10^{-3}	Multiply by .0328	
To change F.P.S. gravitational units to F.P.S. absolute units			
To change F.P.S. absolute units to F.P.S. gravitational units			
To change C.G.S. gravitational units to C.G.S. absolute units			
To change C.G.S. absolute units to C.G.S. gravitational units			
Definition	MASS is the quantity of matter in a body.	LENGTH is the distance between two points measured along a specified path.	TIME is that physical magnitude by which the sequence of events is established.

	1	2	3
Magnitude	Angle[2] (plane)	Area	Volume
Symbol	θ	A	V
Defining Equation		A= K(L x b)	V=K(L x b x h)
Dimensional Formula		L^2	L^3
F.P.S. Gravitational Unit			
C.G.S. Gravitational Unit			
F.P.S. Absolute Unit	RADIAN is the angle at the center subtended by an arc equal in length to the radius of the arc.	SQUARE FOOT is the area of a surface one foot square or its equivalent.	CUBIC FOOT is the volume of a cubic one foot on each edge or its equivalent.
C.G.S. Absolute Unit	RADIAN (Same as above)	SQUARE CENTIMETER is the area of a surface one centimeter square or its equivalent.	CUBIC CENTIMETER is the volume of a cube one centimeter on each edge or its equivalent.
To change F.P.S. gravitational units to C.G.S. gravitational units			
To change C.G.S. gravitational units to F.P.S. gravitational units			
To change F.P.S. absolute units to C.G.S. absolute units		Multiply by 929.03	Multiply by 2.832×10^{4}
To change C.G.S. absolute units to F.P.S. absolute units		Multiply by 1.076×10^{-3}	Multiply by 3.531×10^{-5}
To change F.P.S. gravitational units to F.P.S. absolute units			
To change F.P.S. absolute units to F.P.S. gravitational units			
To change C.G.S. gravitational units to C.G.S. absolute units			
To change C.G.S. absolute units to C.G.S. gravitational units			
Definition	ANGLE (plane) is the opening included between two straight lines which intersect.	AREA is the surface inclosed within definite boundary limits.	VOLUME is a portion of space inclosed within definite boundary limits.

	1	2	3
Magnitude	Angle[3] (solid)	Density	Specific Volume[4]
Symbol	ψ	D	V_S
Defining Equation	$\psi = A/r$	$D = M/V$	$V_S = V/M$
Dimensional Formula		$M\ L^{-3}$	L^3M^{-1}
F.P.S. Gravitational Unit			
C.G.S. Gravitational Unit			
F.P.S. Absolute Unit	SPACE RADIAN OR STERADIAN is a solid angle subtended by an area of one square foot, or its equivalent, on a sphere whose radius is one foot.	POUND PER CUBIC FOOT is the mass in pounds of one cubic foot of a substance.	CUBIC FOOT PER POUND is the volume in cubic feet of one pound of a substance.
C.G.S. Absolute Unit	SPACE RADIAN OR STERADIAN is a solid angle subtended by an area of one square centimeter, or its equivalent, on a sphere whose radius is one centimeter.	GRAM PER CUBIC CENTIMETER is the mass in grams of one cubic centimeter of a substance.	CUBIC CENTIMETER PER GRAM is the volume in cubic centimeters of one gram of a substance.
To change F.P.S. gravitational units to C.G.S. gravitational units			
To change C.G.S. gravitational units to F.P.S. gravitational units			
To change F.P.S. absolute units to C.G.S. absolute units		Multiply by .01602	Multiply by 62.43
To change C.G.S. absolute units to F.P.S. absolute units		Multiply by 62.43	Multiply by .01602
To change F.P.S. gravitational units to F.P.S. absolute units			
To change F.P.S. absolute units to F.P.S. gravitational units			
To change C.G.S. gravitational units to C.G.S. absolute units			
To change C.G.S. absolute units to C.G.S. gravitational units			
Definition	SOLID ANGLE is the opening between the walls of a conical surface of any form.	DENSITY is the quantity of matter in a unit volume of a substance.	SPECIFIC VOLUME is the volume of matter in a unit mass of a substance. It is equal to the reciprocal of the density.

1	2	3
Magnitude	Specific Gravity	Velocity (linear)	Velocity[5] (angular)
Symbol	g_s	v	ω
Defining Equation	$g_s = D_x/D_s$	$v = L/T$	$\omega = \theta/T$
Dimensional Formula		$L\,T^{-1}$	T^{-1}
F.P.S. Gravitational Unit			
C.G.S. Gravitational Unit			
F.P.S. Absolute Unit		FOOT PER SECOND is a velocity such that one foot of distance is passed over in one second	RADIAN PER SECOND is an angular velocity such that the radius sweeps out an angle subtended by an arc equal to the radius, in one second.
C.G.S. Absolute Unit		CENTIMETER PER SECOND is a velocity such that one centimeter of distance is passed over in one second.	RADIAN PER SECOND (Same as above)
To change F.P.S. gravitational units to C.G.S. gravitational units			
To change C.G.S. gravitational units to F.P.S. gravitational units			
To change F.P.S. absolute units to C.G.S. absolute units		Multiply by 30.48	
To change C.G.S. absolute units to F.P.S. absolute units		Multiply by .0328	
To change F.P.S. gravitational units to F.P.S. absolute units			
To change F.P.S. absolute units to F.P.S. gravitational units			
To change C.G.S. gravitational units to C.G.S. absolute units			
To change C.G.S. absolute units to C.G.S. gravitational units			
Definition	SPECIFIC GRAVITY is the ratio of the density of a substance to the density of some other substance taken as a standard. (The standard is water in case of solids, and liquids and air, hydrogen, or oxygen in case of gases)	VELOCITY (linear) is the distance passed over in unit time along a specified path. SPEED is the distance passed over in unit time irrespective of direction.	VELOCITY (angular) is the angle at the center swept out by a radius of a spinning body in a unit of time.

	1	2	3
Magnitude	Acceleration (linear)	Gravity (6)	Acceleration (5) (angular)
Symbol	a	g	α
Defining Equation	a = v /T	g = v/T	$\alpha = \omega$ /T
Dimensional Formula	L T^{-2}	L T^{-2}	T^{-2}
F.P.S. Gravitational Unit			
C.G.S. Gravitational Unit			
F.P.S. Absolute Unit	FOOT PER SECOND PER SECOND is that acceleration in which the velocity changes at the rate of one foot per second each second.	FOOT PER SECOND PER SECOND (See column preceding)	RADIAN PER SECOND PER SECOND is that angular acceleration in which the angular velocity changes at the rate of one radian per second each second.
C.G.S. Absolute Unit	CENTIMETER PER SECOND PER SECOND is that acceleration in which the velocity changes at the rate of one centimeter per second each second.	CENTIMETER PER SECOND PER SECOND. (See column preceding)	RADIAN PER SECOND PER SECOND (Same as above)
To change F.P.S. gravitational units to C.G.S. gravitational units			
To change C.G.S. gravitational units to F.P.S. gravitational units			
To change F.P.S. absolute units to C.G.S. absolute units	Multiply by 30.48	Multiply by 30.48	
To change C.G.S. absolute units to F.P.S. absolute units	Multiply by .0328	Multiply by .0328	
To change F.P.S. gravitational units to F.P.S. absolute units			
To change F.P.S. absolute units to F.P.S. gravitational units			
To change C.G.S. gravitational units to C.G.S. absolute units			
To change C.G.S. absolute units to C.G.S. gravitational units			
Definition	ACCELERATION (linear) is the rate of change of linear velocity.	GRAVITY OR ACCELERATION OF GRAVITY is the linear acceleration of a falling body due to the earths attraction.	ACCELERATION (angular) is the rate of change of angular velocity.

	1	2	3
Magnitude	Force	Weight	Moment of Inertia (7)
Symbol	F	W	I
Defining Equation	F=Ma	W=Mg	$I=\Sigma Mr^2$
Dimensional Formula	M L T^{-2}	M L T^{-2}	M L^2
F.P.S. Gravitational Unit	POUND FORCE is the force required to sustain a mass of one pound in a vacuum.	POUND-FORCE is the force of the attraction of the earth for a mass of one pound.	
C.G.S. Gravitational Unit	GRAM-FORCE is the force required to sustain a mass of one gram in a vacuum.	GRAM-FORCE is the force of the attraction of the earth for a mass of one gram.	
F.P.S. Absolute Unit	POUNDAL is that force which will give an acceleration of one foot per second per second to a mass of one pound.		POUND FOOT-SQUARED is the inertia of a pound mass considered as concentrated at a point, rotating in a circle whose radius is one foot.
C.G.S. Absolute Unit	DYNE is that force which will give an acceleration of one centimeter per second per second to a mass of one gram.		GRAM CENTIMETER-SQUARED is the inertia of a gram mass considered as concentrated at a point, rotating in a circle whose radius is one centimeter
To change F.P.S. gravitational units to C.G.S. gravitational units	Multiply by 453.59	Multiply by 453.9	
To change C.G.S. gravitational units to F.P.S. gravitational units	Multiply by 2.2×10^{-3}	Multiply by 2.2×10^{-3}	
To change F.P.S. absolute units to C.G.S. absolute units	Multiply by 13826		Multiply by 421242.32
To change C.G.S. absolute units to F.P.S. absolute units	Multiply by 7.233×10^{-5}		Multiply by 2.373×10^{-6}
To change F.P.S. gravitational units to F.P.S. absolute units	Multiply by 32.17		
To change F.P.S. absolute units to F.P.S. gravitational units	Multiply by .03108		
To change C.G.S. gravitational units to C.G.S. absolute units	Multiply by 980.7		
To change C.G.S. absolute units to C.G.S. gravitational units	Multiply by 1.02×10^{-3}		
Definition	FORCE is the cause which changes or tends to change the state of motion or state of stress of a body.	WEIGHT is the force of attraction of the earth for bodies on or near its surface.	MOMENT OF INERTIA is the measure of rotational inertia which is that property of a body, capable of spin, in virtue of which it resists a torque tending to change its angular speed.

1	2	3
Magnitude	Torque[8]	Momentum[10] (linear)	Momentum (angular)
Symbol	$\mathcal{T}$	Mo	M_α
Defining Equation	$\mathcal{T} = I\alpha$	Mo = Mv	$M_\alpha = I\omega$
Dimensional Formula	$M\ L^2T^{-2}$	$M\ L\ T^{-1}$	$M\ L^2T^{-1}$
F.P.S. Gravitational Unit	POUND ON FOOT[9] is the torque produced by a force of one pound acting on a lever arm of one foot.		
C.G.S. Gravitational Unit	GRAM ON CENTIMETER is the torque produced by a force of one gram acting on a lever arm of one centimeter.		
F.P.S. Absolute Unit	POUNDAL ON FOOT is the torque produced by a force of one poundal acting on a lever arm of one foot.	POUND FOOT PER SECOND is the momentum of a mass of one pound moving with a velocity of one foot per second.	POUND FOOT-SQUARED RADIAN PER SECOND is the angular momentum of a body whose moment of inertia is one pound foot-squared rotating with an angular velocity of one radian per second.
C.G.S. Absolute Unit	DYNE ON CENTIMETER is the torque produced by a force of one dyne acting on a lever arm of one centimeter.		GRAM CENTIMETER SQUARED RADIAN PER SECOND is the angular momentum of a body whose moment of inertia is one gram centimeter-squared rotating with an angular velocity of one radian per second
To change F.P.S. gravitational units to C.G.S. gravitational units	Multiply by 13826		
To change C.G.S. gravitational units to F.P.S. gravitational units	Multiply by 7.233×10^{-5}		
To change F.P.S. absolute units to C.G.S. absolute units	Multiply by 421416.48	Multiply by 13826	Multiply by 421242.32
To change C.G.S. absolute units to F.P.S. absolute units	Multiply by 2.372×10^{-6}	Multiply by 7.233×10^{-5}	Multiply by 2.373×10^{-6}
To change F.P.S. gravitational units to F.P.S. absolute units	Multiply by 32.17		
To change F.P.S. absolute units to F.P.S. gravitational units	Multiply by .03108		
To change C.G.S. gravitational units to C.G.S. absolute units	Multiply by 980.7		
To change C.G.S. absolute units to C.G.S. gravitational units	Multiply by 1.02×10^{-3}		
Definition	TORQUE is the immediate cause of a change in, or tendency to change, the angular speed of a body.	MOMENTUM(linear) is the physical magnitude which expresses the relationship between the linear velocity of a body and the force causing it in terms of the time required for the body to come to rest.	MOMENTUM(angular) is a physical magnitude which expresses the relationship between the angular velocity of a body and the force causing it in terms of the time required for the spinning body to come to rest.

	1	2	3
Magnitude	Moment of Momentum	Impulse	Moment of Impulse
Symbol	M_M	$\mathcal{I}$	$\mathcal{I}_m$
Defining Equation	$M_M = MvL$	$\mathcal{I} = \int F dt$	$\mathcal{I}_M = \int \mathcal{T} dt$
Dimensional Formula	ML^2T^{-1}	MLT^{-1}	ML^2T^{-1}
F.P.S. Gravitational Unit		POUND SECOND is an impulse which is equivalent to a force of one pound acting for one second.	POUND ON FOOT SECOND is a moment of impulse equal to a torque of one pound on foot acting for one second.
C.G.S. Gravitational Unit		GRAM SECOND is an impulse which is equivalent to a force of one gram acting for one second.	GRAM ON CENTIMETER SECOND is a moment of impulse equal to a torque of one gram on centimeter acting for one second.
F.P.S. Absolute Unit	POUND-FOOT-PER-SECOND ON FOOT is the moment of a momentum of one pound foot per second acting on a lever arm of one centimeter.	POUNDAL SECOND is a force of one poundal acting for one second.	POUNDAL ON FOOT SECOND is a moment of impulse equal to a torque of one poundal on foot acting for one second.
C.G.S. Absolute Unit	GRAM-CENTIMETER-PER-SECOND ON CENTIMETER is the moment of a momentum of one gram centimeter per second acting on a lever arm of one centimeter.	DYNE SECOND is a force of one dyne acting for one second.	DYNE ON CENTIMETER SECOND is a moment of impulse equal to a torque of one dyne on centimeter acting for one second.
To change F.P.S. gravitational units to C.G.S. gravitational units		Multiply by 453.59	Multiply by 13826
To change C.G.S. gravitational units to F.P.S. gravitational units		Multiply by 2.2×10^{-3}	Multiply by 7.233×10^{-5}
To change F.P.S. absolute units to C.G.S. absolute units	Multiply by 421242.32	Multiply by 13826	Multiply by 421242.32
To change C.G.S. absolute units to F.P.S. absolute units	Multiply by 2.373×10^{-6}	Multiply by 7.233×10^{-5}	Multiply by 2.373×10^{-6}
To change F.P.S. gravitational units to F.P.S. absolute units		Multiply by 32.17	Multiply by 32.17
To change F.P.S. absolute units to F.P.S. gravitational units		Multiply by .03108	Multiply by .03108
To change C.G.S. gravitational units to C.G.S. absolute units		Multiply by 980.7	Multiply by 980.7
To change C.G.S. absolute units to C.G.S. absolute units		Multiply by 1.02×10^{-3}	Multiply by 1.02×10^{-3}
Definition	MOMENT OF MOMENTUM is the importance of a linear momentum with respect to maintaining rotation.	IMPULSE, composed of a force acting for an infinitessimally small interval of time, is the cause of a change or tendency to change the momentum of a body.	MOMENT OF IMPULSE, composed of a torque acting for an infinitessimally short time, is the cause of a change, or tendency to change, the angular momentum of a body.

1	2	3
Magnitude	Work	Potential Energy	Kinetic Energy
Symbol	W	$\overline{PE}$	$\overline{KE}$
Defining Equation	$W=-F\ L\ \cos\theta$	$\overline{PE}=-W=-FL\ \cos\theta$	$\overline{KE}=1/2MV^2$
Dimensional Formula	ML^2T^{-2}	ML^2T^{-2}	ML^2T^{-2}
F.P.S. Gravitational Unit	FOOT POUND is the work done by a force of one pound acting through a distance of one foot in the line of motion.	FOOT POUND is the potential energy stored in a body by one foot pound of work.	FOOT POUND is the kinetic energy required to do one foot pound of work.
C.G.S. Gravitational Unit	GRAM CENTIMETER is the work done by a force of one gram acting through a distance of one centimeter in the line of motion.	GRAM CENTIMETER is the potential energy stored in a body by one gram centimeter of work.	GRAM CENTIMETER is the kinetic energy required to do one gram centimeter of work.
F.P.S. Absolute Unit	FOOT POUNDAL is the work done by a force of one poundal acting through a distance of one foot in the line of motion.	FOOT POUNDAL is the potential energy stored in a body by a one foot poundal of work.	FOOT POUNDAL is the kinetic energy required to do one foot poundal of work.
C.G.S. Absolute Unit	ERG is the work done by a force of one dyne acting through a distance of one centimeter in the line of motion.	ERG is the potential energy stored in a body by one erg of work.	ERG is the kinetic energy required to do one erg of work.
To change F.P.S. gravitational units to C.G.S. gravitational units	Multiply by 13826	Multiply by 13826	Multiply by 13826
To change C.G.S. gravitational units to F.P.S. gravitational units	Multiply by 7.233×10^{-5}	Multiply by 7.233×10^{-5}	Multiply by 7.233×10^{-5}
To change F.P.S. absolute units to C.G.S. absolute units	Multiply by 421416.48^5	Multiply by 421416.48	Multiply by 421416.48
To change C.G.S. absolute units to F.P.S. absolute units	Multiply by 2.372×10^{-6}	Multiply by 2.372×10^{-6}	Multiply by 2.372×10^{-6}
To change F.P.S. gravitational units to F.P.S. absolute units	Multiply by 32.17	Multiply by 32.17	Multiply by 32.17
To change F.P.S. absolute units to F.P.S. gravitational units	Multiply by .03108	Multiply by .03108	Multiply by .03108
To change C.G.S. gravitational units to C.G.S. absolute units	Multiply by 980.7	Multiply by 980.7	Multiply by 980.7
To change C.G.S. absolute units to C.G.S. gravitational units	Multiply by 1.02×10^{-3}	Multiply by 1.02×10^{-3}	Multiply by 1.02×10^{-3}
Definition	WORK is the result of a force acting on a body in such a way as to rotate, displace, or distort it.	POTENTIAL ENERGY is the energy a body possesses due to the fact that work has previously been done upon it.	KINETIC ENERGY is that form of energy which a body possesses due to the velocity of its mass.

1	2	3
Magnitude	Power(11)	Pressure	Intensity of Stress
Symbol	P	p	S
Defining Equation	P = W/T	p=F/A	S = F/A
Dimensional Formula	$M L^{2}T^{-3}$	$M L^{-1}T^{-2}$	$M L^{-1}T^{-2}$
F.P.S. Gravitational Unit	FOOT POUND PER SECOND is the power in which work is done at the rate of one foot pound per second.	POUND PER SQUARE FOOT is the pressure of a one pound force acting normally on one square foot.	POUND PER SQUARE FOOT (See preceding column)
C.G.S. Gravitational Unit	GRAM CENTIMETER PER SECOND is the power in which work is done at the rate of one gram centimeter per second.	GRAM PER SQUARE CENTIMETER is a pressure of one gram acting normally on one square centimeter.	GRAM PER SQUARE CENTIMETER (See preceding column)
F.P.S. Absolute Unit	FOOT POUNDAL PER SECOND is the power in which work is done at the rate of one foot poundal per second.	POUNDAL PER SQUARE FOOT is a pressure of one poundal acting normally on one square foot.	
C.G.S. Absolute Unit	ERG PER SECOND is the power in which work is done at the rate of one erg per second.	DYNE PER SQUARE CENTIMETER is a pressure of one dyne acting on one square foot.	
To change F.P.S. gravitational units to C.G.S. gravitational units	Multiply by 13826	Multiply by .4882	Multiply by .4882
To change C.G.S. gravitational units to F.P.S. gravitational units	Multiply by 7.233×10^{-5}	Multiply by 2.04	Multiply by 2.04
To change F.P.S. absolute units to C.G.S. absolute units	Multiply by 421416.48	Multiply by 14.88	Multiply by 14.88
To change C.G.S. absolute units to F.P.S. absolute units	Multiply by 2.372×10^{-6}	Multiply by .067	Multiply by .067
To change F.P.S. gravitational units to F.P.S. absolute units	Multiply by 32.17	Multiply by 32.17	Multiply by 32.17
To change F.P.S. absolute units to F.P.S. gravitational units	Multiply by .03108	Multiply by .03108	Multiply by .03108
To change C.G.S. gravitational units to C.G.S. absolute units	Multiply by 980.7	Multiply by 980.7	Multiply by 980.7
To change C.G.S. absolute units to C.G.S. gravitational units	Multiply by 1.02×10^{-3}	Multiply by 1.02×10^{-3}	Multiply by 1.02×10^{-3}
Definition	POWER is the rate of doing work.	PRESSURE is the intensity of a force i.e. the force acting on unit area	STRESS is a set of forces in equilibrium applied to a body. INTENSITY OF STRESS is the force per unit area tending to produce elastic distortion.

Magnitude	Strain
Symbol	S_N
Defining Equation	$S_N = L_1/(L_2-L_1)$ or $V_1/(V_2-V_1)$
Dimensional Formula	
F.P.S. Gravitational Unit	
C.G.S. Gravitational Unit	
F.P.S. Absolute Unit	
C.G.S. Absolute Unit	
To change F.P.S. gravitational units to C.G.S. gravitational units	
To change C.G.S. gravitational units to F.P.S. gravitational units	
To change F.P.S. absolute units to C.G.S. Absolute units	
To change C.G.S. absolute units to F.P.S. absolute units	
To change F.P.S. gravitational units to F.P.S. absolute units	
To change F.P.S. absolute units to F.P.S. gravitational units	
To change C.G.S. gravitational units to C.G.S. absolute units	
To change C.G.S. absolute units to C.G.S. gravitational units	
Definition	STRAIN is the total elastic distortion produced in a body by the stress applied. It is measured by the ratio of the change produced to the original value of the quantity changed.

Modulus of Elasticity(12)
m
$m = S/S_N$
$M\ L^{-1}\ T^{-2}$
POUND PER SQUARE INCH(13) is that amount of distortion which is produced by a force of one pound acting on an area of square inch.
GRAM PER SQUARE CENTIMETER is that amount of distortion produced by a force of one gram acting on an area of square centimeter.
POUNDAL PER SQUARE INCH is that amount of distortion produced by a force of one poundal acting on an area of one square inch.
DYNE PER SQUARE CENTIMETER is that amount of distortion produced by a force of one dyne acting on an area of one square centimeter.
Multiply by 70.31
Multiply by 1.42
Multiply by 2.143×10^{3}
Multiply by 4.667×10^{-4}
Multiply by 32.17
Multiply by .03108
Multiply by 980.7
Multiply by 1.02×10^{-3}
MODULUS OF ELASTICITY is the measure of an elastic distortion considered as the effect of a force or moment of force.

HEAT

Interpretation of Symbols

M . . . . . mass

L . . . . . length

T . . . . . time

θ . . . . . temperature

H . . . . . heat quantity

$(\theta_2-\theta_1)$ . . . change in temperature

S . . . . . specific heat

W . . . . . work

D . . . . . density

J . . . . . mechanical equivalent of heat

$\overline{TC}_B$ . . . . . thermal capacity of a body

$\overline{TC}_M$ . . . . . thermal capacity of a unit mass of a substance

$\overline{TC}_V$ . . . . . thermal capacity of a unit volume of a substance

$\overline{TC}_{H_2O}$ . . . thermal capacity of a unit mass of water

E_W . . . . . water equivalent

L_F . . . . . heat of fusion

L_V . . . . . heat of vaporization

L_S . . . . . heat of sublimation

K_L . . . . . coefficient of linear expansion

K_A. . . . . .coefficient of surface expansion

K_V. . . . . .coefficient of cubical expansion

K . . . . . .coefficient of thermal conductivity

D_F. . . . . .coefficient of diffusivity

L_I . . . . . initial length

(L_F-L_I) . . change in length

A_I . . . . . initial area

(A_F-A_I) . . . change in area

V_I . . . . . initial volume

(V_F-V_I) . . . change in volume

G . . . . . .temperature gradient

S . . . . . .entropy

(S_2-S_1) . . entropy difference

1	2	3
Magnitude	Temperature	Mechanical Equivalent
Symbol	θ	J
Defining Equation	$H=MS(\theta_2-\theta_1)$	$J=W/H$
Thermal Dimensional Formula	$M\theta$	$L^2T^{-2}\theta^{-1}$
Dynamic Dimensional Formula	$M\,L^2T^{-2}$	L^2T^{-2}
C.G.S. Thermal Unit	GRAM CALORIE is the quantity of heat required to raise the temperature of a gram of water one Centigrade degree.(14)	CENTIGRADE DEGREE is that change in temperature which will produce, in a gas under constant pressure, an increase of volume equal to 1/100 of the increase which takes place when the temperature of the gas passes between the freezing and boiling points of water.(16)	ERGS PER GRAM-CALORIE is the quantity of work in ergs that is necessary to produce one gram-calorie of heat quantity. 4.187 ergs=1 gram-calorie
F.P.S. Thermal Unit	B.T.U.(British Thermal Unit) is the quantity of heat required to raise the temperature of one pound of water one Fahrenheit degree.	FAHRENHEIT DEGREE is that change in temperature which will produce, in a gas under constant pressure, an increase of volume equal to 1/180 of the increase which takes place when the temperature of the gas passes between the freezing and boiling points of water.	FOOT POUNDS PER B.T.U. is the amount of work in foot pounds that is necessary to produce one B.T.U. of heat quantity. 778 foot pounds 1 B.T.U.
To change C.G.S. thermal units to F.P.S. thermal units	Multiply by 3.98×10^{-3}	Multiply by 9/5	Multiply by 1.86×10^{-5}
To change F.P.S. thermal units to C.G.S. thermal units	Multiply by 252	Multiply by 5/9	Multiply by 5.376×10^{4}
Definition	HEAT is that form of energy which a body possesses due to the motion of the molecules, atoms and electrons of which the body is composed.(15)	TEMPERATURE is the thermal condition of a body which determines the direction of resultant flow of heat between it and another body with which it is in thermal contact (15)	MECHANICAL EQUIVALENT of heat is the constant of proportionality that exists between a quantity of heat measured in the energy units of mechanics and the same quantity of heat measured in thermal units.

	1	2	3
Magnitude	Thermal Capacity of a Body	Mass Thermal Capacity of a substance	Volume Thermal Capacity of a substance.
Symbol	$\overline{TC}_B$	$\overline{TC}_M$	$\overline{TC}_V$
Defining Equation	$\overline{TC}_B = H/(\theta_2-\theta_1)$	$\overline{TC}_M = TC_B/M$	$\overline{TC}_V = TC_B/V$ or $D\overline{TC}_M$
Thermal Dimensional Formula	M	M	ML^{-3}
Dynamic Dimensional Formula	$M L^2T^{-2}\theta^{-1}$	$M L^2T^{-2}\theta^{-1}$	$M L^{-1}T^{-2}\theta^{-1}$
C.G.S. Thermal Unit	GRAM-CALORIE PER CENTIGRADE DEGREE is a thermal capacity such that one gram-calorie of heat will raise the temperature of the body one centigrade degree.	GRAM-CALORIE PER GRAM PER CENTIGRADE DEGREE is a thermal capacity such that one gram-calorie of heat will raise the temperature of a gram of a substance one centigrade degree.	GRAM-CALORIE PER CUBIC CENTIMETER PER CENTIGRADE DEGREE is a thermal capacity such that one gram-calorie of heat will raise the temperature of a cubic centimeter of a substance one centigrade degree.
F.P.S. Thermal Unit	B.T.U. PER FAHRENHEIT DEGREE is a thermal capacity such that one B.T.U. of heat will raise the temperature of the body one Fahrenheit degree.	B.T.U. PER POUND PER FAHRENHEIT DEGREE is a thermal capacity such that a B.T.U. of heat will raise the temperature of a pound of the substance one Fahrenheit degree.	B.T.U. PER CUBIC FOOT PER FAHRENHEIT DEGREE is a thermal capacity such that one B.T.U. of heat will raise the temperature of a cubic foot of a substance one Fahrenheit degree.
To change C.G.S. thermal units to F.P.S. thermal units	Multiply by 7.142×10^{-3}	Multiply by 1	Multiply by 62.4
To change F.P.S. thermal units to C.G.S. thermal units	Multiply by 1.40 x 10 2	Multiply by 1	Multiply by $.016 \times 10^{-3}$
Definition	THERMAL CAPACITY OF A BODY is the quantity of heat necessary to raise the temperature of the body one degree.	MASS THERMAL CAPACITY of a substance is the quantity of heat necessary to change the temperature of a unit mass of the substance through one degree of temperature.	VOLUME THERMAL CAPACITY of a substance is the quantity of heat necessary to change the temperature of a unit of the substance through one degree of temperature.

1	2	3
Magnitude	Specific Heat (17)	Water Equivalent	Heat of Fusion
Symbol	S	E_W	L_F
Defining Equation	$S = \overline{TC}_M / \overline{TC}_{H_2O}$	$E_W = MS$	$L_F = H/M$
Thermal Dimensional Formula		M	θ
Dynamic Dimensional Formula		M	L^2T^{-2}
C.G.S. Thermal Unit		GRAM-MASS See table of mechanical units Column 1 Page 15	GRAM-CALORIE PER GRAM is the heat of fusion of a hypothetical solid which would require one gram-calorie of heat to change one gram mass of the substance at its melting temperature to a liquid at the same temperature.
F.P.S. Thermal Unit		POUND-MASS See table of mechanical units Column 1 page 15	B.T.U. PER POUND is the heat of fusion of a hypothetical solid which would require one B.T.U. of heat to change one pound of substance at its melting temperature to a liquid at the same temperature.
To change C.G.S. thermal units to F.P.S. thermal units.		Multiply by 2.205×10^{-3}	Multiply by 9/5
To change F.P.S. thermal units to C.G.S. thermal units.		Multiply by 453.6	Multiply by 5/9
Definition	SPECIFIC HEAT is the ratio of the thermal capacity of a unit mass of a substance to the thermal capacity of a unit mass of water taken as standard.	WATER EQUIVALENT of a body is the mass of water that has the thermal capacity as the body in question. It is numerically equal to the ratio between the thermal capacity of the body and the thermal capacity of a unit mass of water.	HEAT OF FUSION is the quantity of heat necessary to change a unit mass of a solid at its melting temperature to a liquid at the same temperature.

1	2	3
Magnitude	Heat of vaporization	Heat of Sublimation	Coefficient of Linear Expansion(18)
Symbol	L_V	L_S	K_L
Defining Equations	$L_V = H/M$	$L_S = H/M$	$K_L = (L_F - L_I) / L_I(\theta_2 - \theta_1)$
Thermal Dimensional Formula	θ	θ	θ^{-1}
Dynamic Dimensional Formula	L^2T^{-2}	L^2T^{-2}	$L^{-2}T^2$
C.G.S. Thermal Unit	GRAM-CALORIE PER GRAM is the heat of vaporization of a hypothetical liquid which would require one gram-calorie of heat to change one gram mass of the substance from a liquid at its boiling temperature to a vapor at the same temperature.	GRAM-CALORIE PER GRAM is the heat of sublimation of a hypothetical solid which would require one gram-calorie of heat to change one gram mass of the substance at its sublimation temperature to a vapor at the same temperature.	CENTIGRADE COEFFICIENT is the fractional part of its length which a rod will change for each Centigrade degree change in temperature.
F.P.S. Thermal Unit	B.T.U. PER POUND is the heat of vaporization of a hypothetical liquid which would require one B.T.U. of heat to change one pound of the substance from a liquid at its boiling temperature to a vapor at the same temperature.	B.T.U. PER POUND is the heat of sublimation of a hypothetical solid which would require one B.T.U. of heat to change one gram mass of the substance at its sublimation temperature to a vapor at the same temperture.	FAHRENHEIT COEFFICIENT is the fractional part of its length which a rod will change for each Fahrenheit degree change in temperature.
To change C.G.S. thermal units to F.P.S. thermal units	Multiply by 9/5	Multiply by 9/5	Multiply by 5/9
To change F.P.S. thermal units to C.G.S. thermal units	Multiply by 5/9	Multiply by 5/9	Multiply by 9/5
Definition	HEAT OF VAPORIZATION is the amount of heat necessary to change a unit mass of a liquid at its boiling temperature to a vapor at the same temperature.	HEAT OF SUBLIMATION of a solid, which will sublime, is the quantity of heat necessary to change a unit mass of the substance at its sublimation temperature to its vapor at the same temperature.	COEFFICIENT OF LINEAR EXPANSION of a substance is the fractional part of its length which a rod, made of this substance, will change when its temperature is changed one degree.

1	2	3
Magnitude	Coefficient of Surface Expansion	Coefficient of Cubical Expansion	Temperature Gradient
Symbol	K_A	K_V	G
Defining Equation	$K_A=(A_F-A_I)/A_1(\theta_2-\theta_1)=2K_L$	$K=\frac{1}{V}(V_F-V_I)/V(\theta_2-\theta_1)=3K_L$	$G=(\theta_2-\theta_1)/L$
Thermal Dimensional Formula	θ^{-1}	θ^{-1}	$L^{-1}\theta$
Dynamic Dimensional Formula	$L^{-2}T^2$	$L^{-2}T^2$	LT^{-2}
C.G.S. Thermal Unit	CENTIGRADE COEFFICIENT is the fractional part of its area that a sheet of a substance will change for each Fahrenheit change in temperature.	CENTIGRADE COEFFICIENT is the fractional part of its volume that a mass of a substance will change for each centigrade degree change in temperature.	CENTIGRADE DEGREE PER CENTIMETER is that temperature gradient in which the temperature decreases one centigrade degree for each centimeter of length traversed in the direction of heat flow.
F.P.S. Thermal Unit	FAHRENHEIT COEFFICIENT is the fractional part of its area that a sheet of a substance will change for each Fahrenheit change in temperature.	FAHRENHEIT COEFFICIENT is the fractional part of its volume that a mass of a substance will change for each Fahrenheit degree change in temperature.	FAHRENHEIT DEGREE PER FOOT is that temperature gradient in which the temperature decreases one Fahrenheit degree for each foot of length traversed in the direction of heat flow.
To change C.G.S. thermal units to F.P.S. thermal units	Multiply by 5/9	Multiply by 519	Multiply by 55.55
To change F.P.S. thermal units to C.G.S. thermal units	Multiply by 9/5	Multiply by 915	Multiply by .018
Definition	COEFFICIENT OF SURFACE EXPANSION of a substance is the fractional part of its area that a sheet, made of this substance, will change when its temperature is changed one degree.	COEFFICIENT OF CUBICAL EXPANSION of a substance is the fractional parts of its volume that a mass of this substance will change when its temperature is changed one degree.	TEMPERATURE GRADIENT is the rate of decrease of temperature with distance traversed in the direction of heat flow.

1	2	3
Magnitude	Coefficient of Thermal Conductivity	Coefficient of Diffusivity	Entropy Difference[19]
Symbol	K	D	$(S_2 - S_1)$
Defining Equation	$K = HL/AT(\theta_2 - \theta_1)$	$D = K/TC_V$	$(S_2 - S_1) = H/(\theta_2 - \theta_1)$
Thermal Dimensional Formula	$ML^{-1}T^{-1}$	L^2T^{-1}	M
Dynamic Dimensional Formula	$MLT^{-3}\theta^{-1}$	L^2T^{-1}	M
C.G.S. Thermal Unit	GRAM-CALORIE CENTIMETER PER SQUARE CENTIMETER PER SECOND PER CENTIGRADE DEGREE is a thermal conductivity such that one gram-calorie is conducted through a centimeter cube in one second in case the temperature difference is one centigrade degree.	The C.G.S. unit of thermal conductivity divided by the C.G.S. unit of volume thermal capacity of the substance is the unit and is self explanatory.	GRAM-CALORIE PER CENTIGRADE DEGREE is an entropy difference of one gram calorie per one centigrade degree.
F.P.S. Thermal Unit	B.T.U. FOOT PER SQUARE FOOT PER SECOND PER FAHRENHEIT DEGREE is a thermal conductivity such that one B.T.U. is conducted through a foot cube in one second in case the temperature difference is one Fahrenheit degree.	The F.P.S. unit of thermal conductivity divided by the F.P.S. unit of volume thermal capacity of the substance is the unit and is self explanatory.	B.T.U. PER FAHRENHEIT DEGREE is an entropy difference of one B.T.U. per Fahrenheit degree.
To change C.G.S. thermal units to F.P.S. thermal units	Multiply by .0672	Multiply by .072	Multiply by 2.204×10^{-3}
To change F.P.S. thermal units to C.G.S. thermal units	Multiply by 14.88	Multiply by 13.88	Multiply by 453.06
Definition	COEFFICIENT OF THERMAL CONDUCTIVITY is the quantity of heat that a unit cube of a substance will transmit in unit time if the temperature difference between opposite faces, in the direction of heat flow, is one degree.	COEFFICIENT OF DIFFUSIVITY is the increase in temperature produced in a unit cube of a substance by the passage through it of that quantity of heat equivalent to the coefficient of thermal conductivity of the substance in question. DIFFUSIVITY is that property of a substance in virtue of which its temperature is raised due to heat which is conducted through it.	ENTROPY is that quantity which, multiplied by the lowest available temperature, gives the unavailable energy. It is that thermal property of a substance which remains constant so long as heat is neither communicated to or taken from the substance by external bodies.

MAGNETISM

Interpretation of Symbols

M . . . . . mass

L . . . . . length

T . . . . . time

μ . . . . . permeability

A . . . . . area

V . . . . . volume

F . . . . . force

W . . . . . work

m . . . . . strength of magnetic pole

H . . . . . strength of magnetic field in air or vacuo

$\mathcal{M}$ . . . . . magnetic moment

J . . . . . intensity of magnetization

J_V . . . . . volume density of magnetization

J_S . . . . . surface density of magnetization

ϕ . . . . . magnetic flux

H_I . . . . . strength of field in iron

B . . . . . magnetic induction of flux density

U . . . . . magnetic potential difference

$\overline{U}$ . . . . . magnetic potential

M.M. F. . . . magnetomotive force

$\mathcal{R}$ . . . . . reluctance

r . . . . . reluctivity

$\mathcal{P}$ . . . . . permeance

k . . . . . susceptibility

	1	2	3
Magnitude	Magnetic Pole Strength	Magnetic Field in Vacuo or in Air	Magnetic Moment
Symbol	m	H	$\mathcal{M}$
Defining Equation	$m = L\sqrt{F\mu}$	$H = F/m$	$\mathcal{M} = mL$
Dimensional Formula	$M^{\frac{1}{2}} L^{3/2} \mu^{\frac{1}{2}}$	$M^{\frac{1}{2}} L^{-\frac{1}{2}} T^{-1} \mu^{-\frac{1}{2}}$	$M^{\frac{1}{2}} L^{5/2} T^{-1} \mu^{\frac{1}{2}}$
C.G.S. Unit	UNIT POLE is a pole of such strength that, when placed one centimeter distant in vacuo from an equal and like pole, is repelled with a force of one dyne.	GAUSS (20) is a magnetic field that exerts a force of one dyne on a unit pole.	DYNE-ON-CENTIMETER is the torque experienced by a magnet one centimeter between its unit poles when placed with its axis normal to a magnetic field whose intensity is one gauss.
Definition	STRENGTH OF POLE is the quantity of magnetism considered as concentrated on the pole of a magnet.	INTENSITY OF FIELD at a point is a property of a magnetic field which gives rise to mechanical forces if a magnet be brought to that point.	MAGNETIC MOMENT is the torque experienced by a magnet, when placed with its axis across the lines of force in a uniform magnetic field, which tends to rotate it to a position parallel with the field.

1	2	3
Magnitude	Volume Density of Magnetization(21)	Surface Density of Magnetization(21)	Magnetic Flux (22)
Symbol	J_V	J_S	ϕ
Defining Equation	$J_V = m/V$	$J_S = m/A$	$\phi = BA$
Dimensional Formula	$M^{\frac{1}{2}}L^{-\frac{1}{2}}T^{-1}\mu^{\frac{1}{2}}$	$M^{\frac{1}{2}}L^{-\frac{1}{2}}T^{-1}\mu^{\frac{1}{2}}$	$M^{\frac{1}{2}}L^{3/2}T^{-1}\mu^{\frac{1}{2}}$
C.G.S. Unit	DYNE-ON-CENTIMETER PER CUBIC CENTIMETER is a volume density in which one cubic centimeter of the magnet contains unit magnetic moment.	UNIT POLE PER SQUARE CENTIMETER is a surface density in which one square centimeter of a cross section normal to the magnetic lines of force contains a unit pole.	MAXWELL is a flux such that one line of force passes normally through an area of one square centimeter.
Definition	VOLUME DENSITY of magnetization of any portion of a magnetized body is the ratio of the magnetic moment of that portion to its volume.	SURFACE DENSITY of magnet of any area of a magnetized body is the ratio of the number of lines of force passing through that area to the area passed through.	MAGNETIC FLUX is the total number of magnetic lines of force threading a magnetic circuit.

	1	2	3
Magnitude	Field Intensity in Iron	Magnetic Induction	Magnetic Potential
Symbol	H_I	B	$\overline{U}$
Defining Equation	$H_I = 4\pi J$	$B = H + H_I$	$\overline{U} = W/m$
Dimensional Formula	$M^{\frac{1}{2}}L^{-\frac{1}{2}}T^{-1}\ \mu^{\frac{1}{2}}$	$M^{\frac{1}{2}}L^{-\frac{1}{2}}T^{-1}\ \mu^{\frac{1}{2}}$	$M^{\frac{1}{2}}L^{\frac{1}{2}}T^{-1}\ \mu^{-\frac{1}{2}}$
C.G.S. Unit	MAXWELL PER SQUARE CENTIMETER is an intensity of field in iron of one line per square centimeter.	MAXWELL PER SQUARE CENTIMETER is a magnetic induction in iron of one line per square centimeter.	GILBERT is the magnetic potential existing at a point in case an erg of work has been done against the magnetic forces in bringing a unit pole to that point from an infinite distance.
Definition	FIELD INTENSITY IN IRON is the number of magnetic lines produced in the iron by the magnetizing field H.	MAGNETIC INDUCTION is the resultant field in iron due to compounding the field in air (H) with the field in iron (H_I).	POTENTIAL is a property of space whose value at any given point is the work which must be done against the magnetic forces in bringing a quantity of magnetism to that point from an infinite distance.

1	
Magnitude	Magnetic Potential Difference
Symbol	U
Defining Equation	$U = \overline{U}_2 - \overline{U}_1$
Dimensional Formula	$M^{\frac{1}{2}} L^{\frac{1}{2}} T^{-1} \mu^{-\frac{1}{2}}$
C.G.S. Unit	GILBERT is the difference in potential that exists between two points so situated that an erg of work is concerned in the transfer of a unit pole from one point to the other.
Definition	POTENTIAL DIFFERENCE between two points is the excess of the magnetic potential of one point over that of the other or the work concerned in the transfer of the given quantity of magnetism from one point to the other.

2	3
Magnetomotive Force	Reluctance
M M F	$\mathcal{R}$
M.M F= − U	$\mathcal{R} = U/\phi$
$M^{\frac{1}{2}} L^{\frac{1}{2}} T^{-1} \mu^{-\frac{1}{2}}$	$L^{-1} \mu^{-1}$
GILBERT is that magnetomotive force which will produce a potential difference of one gilbert.	OERSTED is that reluctance in which a flux of one maxwell is produced by a differnce of potential of one gilbert.
MAGNETOMOTIVE FORCE is the ability of electricity moving in atoms or in ordinary circuits to set up a magnetic potential difference.	RELUCTANCE is that property of a medium which resists the establishment of magnetic lines of force through it.

	1	2	3
Magnitude	Reluctivity	Permeance(23)	Susceptibility
Symbol	r	$\mathcal{P}$	k
Defining Equation	$r=\mathcal{R}A/L$	$\mathcal{P}=1/\mathcal{R}=\Phi/U$	$k=J\mu/B=J/H=H_I/4\pi H$
Dimensional Formula	$\mu^{-1}L$	$L\mu$	
C.G.S. Unit	OERSTED SQUARE CENTIMETER PER CENTIMETER is a reluctance such that one centimeter cube of a substance offers a reluctance of one oersted.	MAXWELL PER GILBERT is a permeance such that a flux of one maxwell is maintained by a potential difference of one gilbert.	
Definition	RELUCTIVITY is the reluctance of a unit cube of a substance.	PERMEANCE is the ease with which magnetic flux may be established.	SUSCEPTIBILITY is that property of a body which determines the intensity of magnetization which may be produced in the body by a magnetizing force.

ELECTRICITY

Interpretation of Symbols

M . . . . mass

L . . . . length

T . . . . time

A . . . . area

V . . . . volume

μ . . . . permeability

K . . . . dielectric constant

Q . . . . charge

Q_{ES} . . . charge in electrostatic system

Q_{EM} . . . charge in electromagnetic system

H . . . magnetic field intensity

r . . . radius

n . . . number of turns in a coil

σ . . . surface density of charge

ν . . . volume density of charge

I . . . current

i . . . current density

$\mathcal{F}$ . . . electric field intensity

D . . . electric induction or electrostatic flux density

Π . . . electrostatic flux

R . . . resistance

ρ. . . . . resistivity

$\overline{V}$ . . . . . electric potential

V . . . . . electric potential difference

e.m.f. . . . . electromotive force

V_g . . . . . potential gradient

G . . . . . conductance

γ . . . . . conductivity

E . . . . . electrical energy

P . . . . . electrical power

C . . . . . capacity

k . . . . . inductivity

S . . . . . elastance

$\mathcal{L}$ . . . . . inductance

X . . . . . reluctance

Z . . . . . impedance

1	2	3
Magnitude	Charge	Surface Density	Volume Density
Symbol	Q	σ	ν
Defining Equation	$Q_{ES}=L\sqrt{FK}$ | $Q_{EM}=HrT/2\pi n$	$\sigma=Q/A$	$\nu=Q/V$
E.S. Dimensional Formula	$M^{\frac{1}{2}}L^{3/2}T^{-1}K^{\frac{1}{2}}$	$M^{\frac{1}{2}}L^{-\frac{1}{2}}T^{-1}K^{\frac{1}{2}}$	$M^{\frac{1}{2}}L^{-3/2}T^{-1}K^{\frac{1}{2}}$
E.M. Dimensional Formula	$M^{\frac{1}{2}}L^{\frac{1}{2}}\mu^{-\frac{1}{2}}$	$M^{\frac{1}{2}}L^{-3/2}\mu^{-\frac{1}{2}}$	$M^{\frac{1}{2}}L^{-5/2}\mu^{-\frac{1}{2}}$
Electrostatic Unit	STATCOULOMB(24) is that charge which when placed one centimeter distant in vacuo from an equal and like charge, is repelled with a force of one dyne.	STATCOULOMB PER SQUARE CENTIMETER is a density of charge such that one statcoulomb is distributed evenly over one square centimeter of surface.	STATCOULOMB PER CUBIC CENTIMETER is a density of electric quantity such that one statcoulomb is evenly distributed throughout one cubic centimeter of volume.
Electromagnetic Unit	ABCOULOMB(24) is that quantity of electricity which, flowing in one second in a one centimeter length of a conductor bent into an arc of one centimeter radius, will set up a magnetic field at the center of gauss intensity.	ABCOULOMB PER SQUARE CENTIMETER is a density of charge such that one abcoulomb is distributed evenly over one square centimeter of surface.	ABCOULOMB PER CUBIC CENTIMETER is a density of electric quantity such that one abcoulomb is evenly distributed throughout one cubic centimeter of volume.
International or Practical Unit	COULOMB(24) is that quantity of electricity which, when passed through a solution of nitrate of silver in water, will deposit .001118 grams of silver.	COULOMB PER SQUARE CENTIMETER is a density of charge such that one coulomb is distributed evenly over one square centimeter of surface.	COULOMB PER CUBIC CENTIMETER is a density of electric quantity such that one coulomb is evenly distributed throughout one cubic centimeter of volume.
To change electrostatic units to electromagnetic units	Multiply by $1/3 \times 10^{-10}$	Multiply by $1/3 \times 10^{-10}$	Multiply by $1/3 \times 10^{-10}$
To change electromagnetic units to electrostatic units	Multiply by 3×10^{10}	Multiply by 3×10^{10}	Multiply by 3×10^{10}
To change electrostatic units to practical units	Multiply by $1/3 \times 10^{-9}$	Multiply by $1/3 \times 10^{-9}$	Multiply by $1/3 \times 10^{-9}$
To change practical units to electrostatic units	Multiply by 3×10^{9}	Multiply by 3×10^{9}	Multiply by 3×10^{9}
To change electromagnetic units to practical units	Multiply by 10	Multiply by 10	Multiply by 10
To change practical units to electromagnetic units	Multiply by .1	Multiply by .1	Multiply by .1
Definition	ELECTRIC QUANTITY is the actual amount of electricity in terms of electrons and protons. CHARGE is the excess of electric quantity carried by a body of matter. These two terms are used interchangeably.	SURFACE DENSITY is the change per unit area of a charged body.	VOLUME DENSITY is the charge per unit volume of a body or the electric quantity per unit area of free space.

1	2	3
Magnitude	Current	Current Density	Electric Field Intensity
Symbol	I	i	$\mathcal{F}$
Defining Equation	I=Q/T	i=I/A	$\mathcal{F}$=F/Q
E.S. Dimensional Formula	$M^{\frac{1}{2}} L^{3/2} T^{-2} K^{\frac{1}{2}}$	$M^{\frac{1}{2}} L^{-\frac{1}{2}} T^{-2} K^{\frac{1}{2}}$	$M^{\frac{1}{2}} L^{-\frac{1}{2}} T^{-1} K^{-\frac{1}{2}}$
E.M. Dimensional Formula	$M^{\frac{1}{2}} L^{\frac{1}{2}} T^{-1} \mu^{-\frac{1}{2}}$	$M^{\frac{1}{2}} L^{-3/2} T^{-1} \mu^{-\frac{1}{2}}$	$M^{\frac{1}{2}} L^{\frac{1}{2}} T^{-2} \mu^{\frac{1}{2}}$
Electrostatic Unit	STATAMPERE is a strength of current such that one statcoulomb of electric quantity will pass a fixed point in one second.	STATAMPERE PER SQUARE CENTIMETER is a density of current such that one statampere of current is maintained through one square centimeter of area, normal to the direction of the current.	ELECTRIC STATGAUSS(25) is that intensity of field at a point such that one statcoulomb placed at the point, will experience a force of one dyne.
Electromagnetic Unit	ABAMPERE is a strength of current such that one abcoulomb of electric quantity will pass a fixed point in one second.	ABAMPERE PER SQUARE CENTIMETER is a density of current such that one abampere of current is maintained through one square centimeter of area normal to the direction of the current.	ELECTRIC ABGAUSS(25) is that intensity of field at a point such that one abcoulomb placed at the point, will experience a force of one dyne.
International or Practical Unit	AMPERE is a strength of current such that one coulomb of electric quantity will pass a fixed point in one second.	AMPERE PER SQUARE CENTIMETER is a density of current such that one ampere of current is maintained through one square centimeter of area normal to the direction of the current.	ELECTRIC GAUSS(25) is that intensity of field at a point such that one coulomb placed at the point will experience a force of one dyne.
To change electrostatic units to electromagnetic units	Multiply by $1/3 \times 10^{-10}$	Multiply by $1/3 \times 10^{-10}$	Multiply by 3×10^{10}
To change electromagnetic units to electrostatic units	Multiply by 3×10^{10}	Multiply by 3×10^{10}	Multiply by $1/3 \times 10^{-10}$
To change electrostatic units to practical units	Multiply by $1/3 \times 10^{-9}$	Multiply by $1/3 \times 10^{-9}$	Multiply by 3×10^{9}
To change practical units to electrostatic units	Multiply by 3×10^{9}	Multiply by 3×10^{9}	Multiply by $1/3 \times 10^{-9}$
To change electromagnetic units to practical units	Multiply by 10	Multiply by 10	Multiply by .1
To change practical units to electromagnetic units	Multiply by .1	Multiply by .1	Multiply by 10
Definition	CURRENT or CURRENT INTENSITY is the quantity of electricity passing a fixed point in a given time.	CURRENT DENSITY is the current per unit cross section of area taken normal to the direction of the current.	FIELD INTENSITY at a point is the property of the field giving rise to mechanical forces if a charge be placed at the point. It is of the nature of a stress which would act on a charge placed at the point.

1	2	3
Magnitude	Electric Induction	Electrostatic Flux	Resistance
Symbol	D	Π	R
Defining Equation	$D=K\mathcal{F}/4\pi$	$\Pi=DA$	$R= H/I^2T$ H=heat
E.S. Dimensional Formula	$M^{\frac{1}{2}}L^{-\frac{1}{2}}T^{-1}K^{\frac{1}{2}}$	$M^{\frac{1}{2}}\ L^{3/2}T^{-1}K^{\frac{1}{2}}$	$L^{-1}\ T\ K^{-1}$
E.M. Dimensional Formula	$M^{\frac{1}{2}}L^{-3/2}\ \mu^{-\frac{1}{2}}$	$M^{\frac{1}{2}}\ L^{\frac{1}{2}}\ \mu^{-\frac{1}{2}}$	$L\ T^{-1}\ \mu$
Electrostatic Unit	STATMAXWELL PER SQUARE CENTIMETER is the induction in a medium of unit dielectric constant at a point where the electric intensity of field is 4π electric stat gausses.	STATMAXWELL is the total number of electrostatic lines of force emanating from a point charge of one statcoulomb intensity.	STATOHM is that resistance in which a quantity of heat equal to one erg of energy is produced in one second by the passage of one statcoulomb of electricity.
Electromagnetic Unit	ABMAXWELL PER SQUARE CENTIMETER is the induction in a medium of unit dielectric constant at a point where the electric intensity of field is 4π electric abgausses.	ABMAXWELL is the total number of electrostatic lines of force emanating from a point charge of one abcoulomb intensity.	ABOHM is that resistance in which a quantity of heat equal to one erg of energy is produced in one second by the passage of one abcoulomb of electricity.
International or Practical Units	MAXWELL PER SQUARE CENTIMETER is the induction in a medium of unit dielectric constant at a point where the electric intensity of field is 4 electric gausses.	MAXWELL is the total number of electrostatic lines of force emanating from a point charge of one coulomb intensity.	OHM (26) is the resistance offered by a uniform column of mercury 106.3 centimeters long and 14.4521 grams in mass at 0°C.
To change electrostatic units to electromagnetic units	Multiply by 3×10^{10}	Multiply by 3×10^{-10}	Multiply by 9×10^{20}
To change electromagnetic units to electrostatic units	Multiply by $1/3 \times 10^{-10}$	Multiply by $1/3 \times 10^{-10}$	Multiply by $1/9 \times 10^{-20}$
To change electrostatic units to practical units	Multiply by 3×10^{9}	Multiply by 3×10^{9}	Multiply by 9×10^{11}
To change practical units to electrostatic units	Multiply by $1/3 \times 10^{-9}$	Multiply by $1/3 \times 10^{9}$	Multiply by $1/9 \times 10^{-11}$
To change electromagnetic units to practical units	Multiply by .1	Multiply by .1	Multiply by 10^{-9}
To change practical units to electromagnetic units	Multiply by 10	Multiply by 10	Multiply by 10^{9}
Definition	ELECTRIC INDUCTION is the electric strain established in a medium under the action of a stress exerted on that medium by an electric field. Electric induction is represented by lines similar to lines of force. FLUX DENSITY is the number of lines of electrostatic flux per unit of area.	ELECTROSTATIC FLUX isthe total number of lines of electrostatic induction through a given area.	RESISTANCE is that property of an electric conductor in virtue of which it opposes the flow of electricity and causes the transformation of electrical energy into heat.

1	2	3
Magnitude	Resistivity	Potential	Potential Difference
Symbol	ρ	$\bar{V}$	V
Defining Equation	$\rho = RA/L$	$\bar{V}=W/Q$	$V = \bar{V}_2 - \bar{V}_1 = RI$
E.S. Dimensional Formula	$T\ K^{-1}$	$M^{\frac{1}{2}}L^{\frac{1}{2}}T^{-1}K^{-\frac{1}{2}}$	$M^{\frac{1}{2}}L^{\frac{1}{2}}T^{-1}K^{-\frac{1}{2}}$
E.M. Dimensional Formula	$L^2T^{-1}\ \mu$	$M^{\frac{1}{2}}L^{3/2}\ T^{-2}\ \mu^{\frac{1}{2}}$	$M^{\frac{1}{2}}L^{3/2}\ T^{-2}\ \mu^{\frac{1}{2}}$
Electrostatic Unit	STATOHM CENTIMETER SQUARED PER CENTIMETER is the resistance measured in statohms of a centimeter cube of a substance used as a conductor.	STATVOLT is the potential that exists at a point in case an erg of work has been done against electric forces in bringing a statcoulomb of electricity to that point from an infinite distance.	STATVOLT is the difference of potential that exists between two points so situated that an erg of work is concerned in the transfer of a charge of one statcoulomb between the points.
Electromagnetic Unit	ABOHM CENTIMETER SQUARED PER CENTIMETER is the resistance measured in abohms of a centimeter cube of a substance used as a conductor.	ABVOLT is the potential that exists at a point in case an erg of work has been done against electric forces in bringing an abcoulomb of electricity to that point from an infinite distance.	ABVOLT (27) is the difference in potential which is necessary to force an abcoulomb of electricity through a resistance of one abohm in one second.
International or Practical Unit	OHM CENTIMETER SQUARED PER CENTIMETER is the resistance measured in ohms of a centimeter cube of a substance used as a conductor.	VOLT is the potential that exists at a point in case an erg of work has been done against electric forces in bringing a coulomb of electricity to that point from an infinite distance.	VOLT(27) is the difference in potential which is necessary to cause a coulomb of electricity to flow through a resistance of one ohm in one second. It is a joule per coulomb.
To change electrostatic units to electromagnetic units	Multiply by 9×10^{20}	Multiply by 3×10^{10}	Multiply by 3×10^{10}
To change electromagnetic units to electrostatic units	Multiply $1/9 \times 10^{-20}$	Multiply by $1/3 \times 10^{-10}$	Multiply by $1/3 \times 10^{-10}$
To change electrostatic units to practical units	Multiply 9×10^{11}	Multiply by 300	Multiply by 300
To change practical units to electrostatic units	Multiply $1/9 \times 10^{-11}$	Multiply by .003	Multiply by .003
To change electromagnetic units to practical units	Multiply by 10^{-9}	Multiply by 10^{-8}	Multiply by 10^{-8}
To change practical units to electromagnetic units	Multiply by 10^{9}	Multiply by 10^{8}	Multiply by 10^{8}
Definition	RESISTIVITY is that property of a substance upon which the resistance of a conductor made of this material depends. It is the resistance of a unit cube of a substance.	POTENTIAL is a property of space whose value at any point is the work which must be done against electric forces in bringing a quantity of electricity to that point from an infinite distance.	POTENTIAL DIFFERENCE between two points is the excess of the electrical potential of one point over that of the other point. It is measured by the work concerned in the transfer of the given quantity of electricity from one point to the other.

1	2	3
Magnitude	Electromotive Force	Potential Gradient	Conductance
Symbol	e.m.f.	Vg	G
Defining Equation	e.m.f.=-V	Vg=V/L	G=1/R=I/V
E.S. Dimensional Formula	$M^{\frac{1}{2}}L^{\frac{1}{2}}T^{-1}K^{-\frac{1}{2}}$	$M^{\frac{1}{2}}L^{\frac{1}{2}}\ T^{-1}K\ ^{-\frac{1}{2}}$	$L\ T^{-1}K$
E.M. Dimensional Formula	$M^{\frac{1}{2}}L^{3/2}\ T^{-2}\ \mu^{\frac{1}{2}}$	$M^{\frac{1}{2}}L^{\frac{1}{2}}T^{-2}\ \mu^{\frac{1}{2}}$	$L^{-1}T\ \mu^{-1}$
Electrostatic Unit	STATVOLT is that amount of work which must be done agains electric forces in establishing a potential difference of one statvolt. It is equal to an erg per statcoulomb.	STATVOLT PER CENTIMETER is an electric field such that for each centimeter of distance along the direction of electric force the potential decreases one statvolt.	STATMHO(28) is the conductance of a circuit having a resistance of one statohm.
Electromagnetic Unit	ABVOLT is that amount of work which must be done against electric forces in establishing a potential difference of one abvolt. It is equal to an erg per abcoulomb.	ABVOLT PER CENTIMETER is an electric field such that for each centimeter of distance along the direction of the electric force the potential decreases by one abvolt.	ABMHO(28) is the conductance of a circuit in which a potential difference of one abvolt will maintain a current of one abampere.
International or Practical Unit	VOLT is that amount of work which must be done against electric forces in establishing a potential difference of one volt. It is equal to a joule per coulomb.	VOLT PER CENTIMETER is an electric field such that for each centimeter of distance along the direction of the electric force the potential decreases by one volt.	MHO(28) is the conductance of a uniform column of mercury 106.3 centimeters long and 14.4521 grams in mass at 0°C.
To change electrostatic units to electromagnetic units	Multiply by 3×10^{10}	Multiply by 3×10^{10}	Multiply by $1/9 \times 10^{-20}$
To change electromagnetic units to electrostatic units	Multiply by $1/3 \times 10^{-10}$	Multiply by $1/3 \times 10^{-10}$	Multiply by 9×10^{20}
To change electrostatic units to practical units	Multiply by 300	Multiply by 300	Multiply by $1/9 \times 10^{-11}$
To change practical units to electrostatic units	Multiply by .003	Multiply by .003	Multiply by 9×10^{11}
To change electromagnetic units to practical units	Multiply by 10^{-8}	Multiply by 10^{-8}	Multiply by 10^{9}
To change practical units to electromagnetic units	Multiply by 10^{8}	Multiply by 10^{8}	Multiply by 10^{-9}
Definition	ELECTROMOTIVE FORCE is that property of a machine or device by virtue of which it can convert some form of energy into electrical energy. It is measured by the work per unit quantity of electricity done against electric forces by a machine in establishing a potential difference.	POTENTIAL GRADIENT is the space rate of decrease of the potential in an electric field in the direction of the electric force.	CONDUCTANCE is the reciprocal of resistance. It represents the ease with which a conductor conveys an electric current.

1	2	3
Magnitude	Conductivity	Electrical Energy	Electrical Power
Symbol	γ	E	P
Defining Equation	$\gamma = 1/\rho = L/RA$	E = VQ	P = VI
E.S. Dimensional Formula	$T^{-1}K$	$M L^2T^{-2}$	$M L^2T^{-3}$
E.M. Dimensional Formula	$L^{-2}T \mu^{-1}$	$M L^2T^{-2}$	$M L^2T^{-3}$
Electrostatic Unit	STATMHO CENTIMETER PER SQUARE CENTIMETER is the conductivity measured in statmhos of a conductor one centimeter long and one square centimeter in cross sectional area.	ERG is that amount of energy equivalent to the work done when a statcoulomb falls through a difference of potential of one statvolt.	STATWATT is the expenditure of electrical energy at the rate of one erg per second.
ELectromagnetic Unit	ABMHO CENTIMETER PER SQUARE CENTIMETER is the conductivity measured in abmhos of a conductor one centimeter long and one square centimeter in cross sectional area.	ERG is that amount of energy equivalent to the work done when an abcoulomb falls through a potential difference of one abvolt.	ABWATT is the expenditure of electrical energy at the rate of one erg per second.
International or Practical Unit	MHO CENTIMETER PER SQUARE CENTIMETER is the conductivity measured in mhos of a conductor one centimeter long and one square centimeter in cross sectional area.	JOULE is that amount of energy equivalent to the work done when a coulomb falls through a potential difference of one volt.	WATT is the expenditure of electrical energy at the rate of one joule per second.
To change electrostatic units to electromagnetic units	Multiply by $1/9 \times 10^{-20}$	Multiply by 1	Multiply by 1
To change electromagentic units to electrostatic units	Multiply by 9×10^{20}	Multiply by 1	Multiply by 1
To change electrostatic units to practical units	Multiply by $1/9 \times 10^{-11}$	Multiply by 10^7	Multiply by 10^7
To change practical units to electrostatic units	Multiply by 9×10^{11}	Multiply by 10^{-7}	Multiply by 10^{-7}
To change electromagnetic units to practical units	Multiply by 10^9	Multiply by 10^7	Multiply by 10^7
To change practical units to electromagnetic units	Multiply by 10^{-9}	Multiply by 10^{-7}	Multiply by 10^{-7}
Definition	CONDUCTIVITY is the reciprocal of resistivity. It represents the ease with which a unit cube of a conductor conveys an electric current.	ELECTRICAL ENERGY is the ability of electricity, under certain conditions, to do work. Energy as used in mechanics can be expressed in electrical terms.	ELECTRICAL POWER is the time rate of expenditure of electrical energy.

	1	2	3
Magnitude	Capacity	Inductivity	Elastance
Symbol	C	k	S
Defining Equation	C=Q/V	=CL/A	S=1/C V/Q
E.S. Dimensional Formula	LK	K	$L^{-1}K^{-1}$
E.M. Dimensional Formula	$L^{-1}T^{2}$ μ^{-1}	$L^{-2}T^{2}$ μ^{-1}	$L\,T^{-2}\mu$
Electrostatic Unit	STATFARAD is the capacity of a condenser which is changed to a potential difference of one stat volt by one statcoulomb of electricity.	STATFARAD CENTIMETER PER SQUARE CENTIMETER is the capacity measured in statfarads of a centimeter cube of a dielectric.	STATDARAF(30) is the elastance of a condenser having a capacity of one statfarad.
Electromagnetic Unit	ABFARAD is the capacity of a condenser which is charged to a potential difference of one abvolt by one abcoulomb of electricity.	ABFARAD CENTIMETER PER SQUARE CENTIMETER is the capacity measured in abfarads of a centimeter cube of a dielectric.	ABDARAF(30) is the elastance of a condenser having a capacity of one abfarad.
International or Practical Unit	FARAD(29) is the capacity of a condenser which is charged to a potential difference of one volt by one coulomb of electricity.	FARAD CENTIMETER PER SQUARE CENTIMETER is the capacity measured in farads of a centimeter cube of a dielectric.	DARAF(30) is the elastance of a condenser having a capacity of one farad.
To change electrostatic units to electromagnetic units	Multiply by $1/9 \times 10^{-20}$	Multiply by $1/9 \times 10^{-20}$	Multiply by 9×10^{20}
To change electromagnetic units to electrostatic units	Multiply by 9×10^{20}	Multiply by 9×10^{20}	Multiply by $1/9 \times 10^{-20}$
To change electrostatic units to practical units	Multiply by $1/9 \times 10^{-11}$	Multiply by $1/9 \times 10^{-11}$	Multiply by 9×10^{11}
To change practical units to electrostatic units	Multiply by 9×10^{11}	Multiply by 9×10^{11}	Multiply by $1/9 \times 10^{-11}$
To change electromagnetic units to practical units	Multiply by 10^{9}	Multiply by 10^{9}	Multiply by 10^{-9}
To change practical units to electromagnetic units	Multiply by 10^{-9}	Multiply by 10^{-9}	Multiply by 10^{-9}
Definition	CAPACITY is that property of a condenser in virtue of which it is able to transform, electrical energy into mechanical strain in the dielectric during the charging process and mechanical strain into electrical energy during discharge.	INDUCTIVITY or specific inductive capacity is the inherent ability of a medium for conveying the influence of an electric charge through it. It is the capacity of a unit cube of the material. DIELECTRIC CONSTANT is the ratio of inductivity of a medium to the inductivity of free space. PERMITTIVITY is the fractional part of the dielectric constant given by the formula p=K/4	ELASTANCE is the reciprocal of the capacity and respresents the "stiffness" of a condenser or the opposition offered to the transformation of electrical energy into a mechanical strain in the dielectric.

1	2	3
Magnitude	Inductance	Reactance	Impedance
Symbol	$\mathcal{L}$	X	Z
Defining Equation	$\mathcal{L}$=e.m.f/dI/dT	$X=X_L-X_C$	$Z=\sqrt{R^2+(X_L-X_C)^2}$
E.S. Dimensional Formula	$L^{-1}T^2K^{-1}$	$L^{-1}T\ K^{-1}$	$L^{-1}T\ K^{-1}$
E.M. Dimensional Formula	$L\ \mu$	$L\ T^{-1}\mu$	$L\ T^{-1}\mu$
Electrostatic Unit	STATHENRY is the inductance of a circuit in which a variation of the inducing current at the rate of one statampere per second will produce an electromotive force of one statvolt.	STATOHM See unit of resistance Column 3 Page 45	STATOHM See unit of resistance Column 3 Page 45
Electromagnetic Unit	ABHENRY is the inductance of a circuit in which a variation of the inducing current at the rate of one abampere per second will produce an electromotive force of one abvolt.	ABOHM See unit of resistance Column 3 Page 45	ABOHM See unit of resistance Column 3 Page 45
International or Practical Unit	HENRY is the inductance of a circuit in which a variation of the inducing current at the rate of one ampere per second will produce an electromotive force of one volt.	OHM See unit of resistance Column 3 Page 45	OHM See unit of resistance Column 3 Page 45
To change electrostatic units to electromagnetic units	Multiply by 9×10^{20}	Multiply by 9×10^{20}	Multiply by 9×10^{20}
To change electromagentic units to electrostatic units	Multiply by $1/9 \times 10^{-20}$	Multiply by $1/9 \times 10^{-20}$	Multiply by $1/9 \times 10^{-20}$
To change electrostatic units to practical units	Multiply by 9×10^{11}	Multiply by 9×10^{11}	Multiply by 9×10^{11}
To change practical units to electrostatic units	Multiply by $1/9 \times 10^{-11}$	Multiply by $1/9 \times 10^{-11}$	Multiply by $1/9 \times 10^{-11}$
To change electromagnetic units to practical units	Multiply by 10^{-9}	Multiply by 10^{-9}	Multiply by 10^{-9}
To change practical units to electromagnetic units	Multiply by 10^{9}	Multiply by 10^{9}	Multiply by 10
Definition	SELF INDUCTANCE is the result of a time rate of a current charged in a circuit acting in such a way as to produce a counter electromotive force in the same circuit. MUTUAL INDUCTANCE is the result of a time rate of a current charge in one circuit acting in such a way as to produce a counter electromotive force in another circuit linked magnetically with it.	INDUCTIVE REACTANCE-X_L-is the opposition offered by the electromotive force of induction to a current and is given by the formula $X_L=2\ f$ where f is the frequency of the current in cycles per second. CAPACITY REACTANCE X_C- is the opposition offered by a condenser to a current and is given by $X_C=1/2\ fC$. RESULTANT REACTANCE is the difference between the inductive reactance and the capacity reactance in a circuit.	IMPEDANCE is the total opposition offered to any current by the combined resistance of the conductors and the resultant reactance of the circuit.

LIGHT

Interpretation of Symbols

M . . . . . mass

L . . . . . length

T . . . . . time

A . . . . . area

I . . . . . luminous intensity

D_F . . . . . illumination intensity

B_I . . . . . intrinsic brightness

B_S . . . . . surface brightness

1	2	3
Magnitude	Luminous Flux	Illumination Intensity
Symbol	F	D_F
Defining Equation	$F = \sum E/T$	$D_F = F/A$
Dimensional Formula	$M\ L^{-2}T^{-3}$	$M\ L^{-1}T^{-3}$
C.G.S. Unit	LUMEN is the amount of luminous flux which is emitted by a source of one candle of luminous intensity through one space radian.	LUX is an intensity of illumination such that one lumen of flux is intercepted by one square meter of surface.
F.P.S. Unit	LUMEN is the amount of luminous flux which is emitted by a source of one candle of luminous intensity through one space radian.	FOOT CANDLE (32) is an intensity of illumination such that one lumen of flux is intercepted by one square foot of surface.
To change C.G.S. units to F.P.S. units		Multiply by .093
To change F.P.S. units to C.G.S. units		Multiply by 10.76
Definition	LUMINOUS FLUX is the total radiant energy, producing visual sensation, emitted per second by a light source.	ILLUMINATION INTENSITY is the measure of the amount of luminous flux which is intercepted by a surface.

1
Luminous Intensity
I
$I = F$
$ML^2\ T^{-3}$
CANDLE (31) is the luminous intensity of a light source, of certain specifications, that has been adopted as standard by France, England, and the United States.
CANDLE (31) is the luminous intensity of a light source, of certain specifications, that has been adopted as standard by France, England, and the United States.
LUMINOUS INTENSITY is the measure of the ability of a light source to emit a radiant energy stream which produces visual sensation.

	1	2
Magnitude	Intrinsic Brightness	Surface Brightness
Symbol	B_I	B_S
Defining Equation	$B_I = E/A$	$B_S = F/A$
Dimensional Formula	$ML^{-1}T^{-3}$	$ML^{-1}T^{-3}$
C.G.S. Unit	CANDLE PER SQUARE CENTIMETER is an intrinsic brightness such that one candle of luminous flux is emitted by one square centimeter of a luminous surface.	LAMBERT is the brightness of a perfectly diffusing surface reflecting one lumen per square centimeter of surface.
F.P.S. Unit	CANDLE PER SQUARE INCH is an intrinsic brightness such that one candle of luminous flux is emitted by one square inch of a luminous surface.	LUMEN PER SQUARE FOOT is the brightness of a perfectly diffusing surface reflecting one lumen per square foot of surface.
To change C.G.S. units to F.P.S. units	Multiply by 6.452	Multiply by 929
To change F.P.S. units to C.G.S. units	Multiply by .155	Multiply by 1.076×10^{-3}
Definition	INTRINSIC BRIGHTNESS is the apparent luminous intensity of a unit area of a perfectly luminous surface.	SURFACE BRIGHTNESS is the apparent luminous intensity of a unit area of a perfectly diffusing surface.

SUPPLEMENT

(1) The slug or mydron is a unit of mass which is used in England. It is defined as that mass to which a force of one pound will give an acceleration of one foot per second per second. The slug is a derived unit, being derived as the definition would indicate, from the equation F=Ma. Therefore, since it is a derived unit, it would not appear in the mass column in the table where mass is treated as a fundamental unit. The conversion factor between the slug and the pound is gravity, which is generally used as 32.17.

(2) The unit of angle measurement in the sexigessimal system is the degree. It is defined as 1/360 of the plane angle about a point. The conversion factor between radians and degrees is 57.3 i.e. one radian equals 57.3 degrees.

(3) The numerical value of a unit solid angle is the same regardless of the unit used in measuring the area and the radius provided that the area is expressed as the square of the unit used in measuring the radius.

(4) Inverse density is a preferable term since it is convenient to express this magnitude in terms of units. See general preface for a discussion of the word specific. Specific density and relative density are other names for specific gravity. Specific gravity remains constant irrespective of the units used in its measurement. It is

numerically equal to the density measured in C.G.S. units.

(5) In all computations involving angular velocity the angle must be expressed in radians.

(6) The acceleration of gravity varies from about 978 centimeters per second per second at the equator to about 983 centimeters per second at the poles.

(7) Linear inertia is that property of a body in virtue of which it resists any force tending to change its linear speed. The measure of linear inertia is mass.

Rotational inertia is that property of a body, capable of spin, in virtue of which it resists a torque tending to change its angular speed. The measure of rotational inertia is called moment of inertia.

(8) Torque is considered by some authors as the effect of a moment of force. However, it seems advisable to use torque as synonomous with moment of couple, moment of force, and twisting motive, i.e. as the cause of rotation or twist. See Smithsonian tables and college text books of physics by Anderson, Caswell, Smith, etc.

(9) The units of torque are unfortunately named in that, since they are the product of force units by length units, they are erroneously confused with work units. Therefore, it seems advisable to make an attempt to distinguish between them by naming the torque units pound-on-foot and gram-on-

centimeter etc., meaning that a force of one pound acts on a lever arm of one foot or a force of one gram acts on a lever arm of one centimeter.

(10) Energy is the ability to change the state of motion or state of stress of a body in opposition to the forces acting. In contrast to momentum, kinetic energy is defined as the physical magnitude which expresses the relationship between the velocity and the force causing it in terms of the distance the body will move before coming to rest.

Work is numerically equal to the kinetic energy is equal to the potential energy in a closed system.

(11) A larger unit of power is called the horse power. This unit is equivalent to 550 foot pounds per second or 33000 foot pounds per minute.

(12) The following moduli and their equations can be derived from the fundamental equation $M=S/S_N$: Youngs Modulus, $Y=FL/A(L_2-L)$, in which (F) is equal to the force, (A) is the area over which the force is applied, (L) is the original length and (L_2-L) is the elongation; Torsional Modulus or coefficient of rigidity $n=2TL/r^4\theta$ in which (T) is the torque, (L) is the length of the rod, (r) is the radius of the rod, and θ is the angular displacement produced by the torque; Volume or Bulk Modulus $k=PV/A(V_2-V)$

in which (F) is the total force, (A) is the total area over which the force is applied, (V) is the original volume and (V_2-V) is the change in volume produced.

Compressibility is the reciprocal of the volume modulus.

Resilience is the work done per unit volume of a body in distorting it to the elastic limit. It has the same dimensions as Modulus of Elasticity.

(13) In the Modulus of Elasticity the square inch, which is 1/144 of the square foot, is used as the unit of area.

(14) The amount of heat required to raise the temperature of water one degree is not the same for all of the degrees between 0°C and 100°C. Therefore, the exact amount of heat in one gram calorie is not fixed until the temperature change has been specified. Various temperature changes have been suggested for standardization. Examples are from 0° to 1°, 15° to 16° and 19° to 20°. However, no standard has yet been fixed.

(15) Heat, until the time of Count Rumford, was considered as an indestructible, imponderable fluid which flowed from a substance of higher temperature to one of lower temperature. Consequently, the thermal units have been defined from this point of view. Heat has since been proved to be a form of energy. Hence, it can be measured in energy units. The defining equation, from this point of view,

is $H=1/2\ MV^2$ where M is the total mass of the molecules composing the body and V their mean speed.

The difference between heat and temperature is here shown plainly; heat is not only proportional to the mean square speed of the molecules, but also to their mass; temperature is proportional to the mean square speed and is independent of the mass.

(16) The temperature of a gas is a function of the pressure as well as the volume, consequently, a unit of temperature based upon the properties of a gas could be defined in terms of the volume under constant pressure or in terms of the pressure with constant volume. The one given in the tables is in terms of the volume under constant pressure. This was given to show, the relation of the centigrade degree to the Fahrenheit degree. The definition of a degree centigrade in terms of the pressure of a gas with constant volume is, the change in temperature which will produce in a gas of constant volume, an increase in pressure which is 1/273 of the increase which takes place when the temperature of the gas passes between the freezing point and the boiling point of water.

(17) There are two specific heats of a solid or liquid, the mass specific heat, given in the table, and the volume specific heat. The latter is defined as the ratio of the

thermal capacity of a unit volume of a substance to the thermal capacity of a unit volume of water. The volume specific heat (S_v)is given by the formula $S_V=Sg_S$ where (S) is the mass specific heat and (g_S) is the specific gravity of the substance.

There are two specific heats of a gas, one is the specific heat at constant pressure and the other is the specific heat at constant volume.

(18) The temperature at which it is measured is a function of the coefficients of expansion of a substance.

(19) Entropy difference is the quantity which is susceptible to measurement. Entropy difference has units, while entropy itself does not due to the fact that temperature as such has no units.

(20) The magnetic field, when considered as the magnetizing force, has the unit maxwell per square centimeter. This is obtained by solving the defining equation of magnetic flux for (H). Another unit which is sometimes used for magnetic field is the gilbert per centimeter which is found by solving the equation H=U/L in which U is the magnetic potential difference, and L is length.

(21) The volume density of magnetization and the surface density of magnetization are numerically equal. They are both referred to as the intensity of magnetization (J).

(22) In media other than air or free space the defining equation becomes $\phi=BA$, where B is the flux density of the medium in question.

(23) The name destreo has been suggested for the unit of permeance.

(24) The electron equivalent of each of the units of charge is as follows:

statcoulomb= 2.09×10^{9} electrons

abcoulomb= 6.28×10^{19} electrons

coulomb= 6.28×10^{18} electrons

(25) Since the unit magnetic field has been named the gauss the suggestion to name the electric field the electric gauss appears to be justifiable.

(26) The ohm may also be defined as that resistance in which a quantity of heat, equal to one joule of energy per second, is produced by a current intensity of one ampere.

(27) The abvolt and the volt may also be defined similar to the statvolt. The abvolt would then be defined as the difference in potential that exists between two points so situated that an erg of work is concerned in the transfer of a charge of one abcoulomb between the points. The volt would be defined as the difference in potential that exists between two points when one joule of work is concerned in the transfer of a charge of one coulomb between the points.

(28) Inverse ohm is preferable to the term mho since the latter is the reverse of the ohm and the idea to be expressed is not the reverse but the inverse of the unit of resistance.

(29) The more commonly used unit is the microfarad which is equal to 10^{-6} farads or 10^{-15} abfarads.

(30) Inverse farad is preferable to the term daraf since the latter is the reverse of the farad instead of the inverse. The inverse of the capacity is the idea to be expressed.

(31) The Hefner which is .9 of the standard candle is the unit of luminous intensity used in Germany.

(32) Foot candle may also be defined as the intensity of illumination incident upon a surface, normal to the energy stream, one foot distant from a source of one candle of luminous intensity.

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