

# Workshop Calculation & Science

**UNITS**

pdf-2

## Units and abbreviations

Quantity	Units	Abbreviation of unit
Calorific value	kilojoules per kilogram	kJ/kg
Specific fuel consumption	kilogram per hour per newton	kg/hr/N
Length	millimetre, metre, kilometre	mm, m, km
Mass	kilogram, gram	kg, g
Time	seconds, minutes, hours	s, min, h
Speed	centimetre per second, metre per second, kilometre per hour, miles per hour	cm/s, m/s, km/h, mph
Acceleration	metre-per-square second	m/s <sup>2</sup>
Force	newtons, kilonewtons	N, kN
Moment	newton-metres	Nm
Work	joules	J
Power	horsepower, watts, kilowatts	Hp, W, kW
Pressure	newton per square metre, kilonewton per square metre	N/m <sup>2</sup> , kN/m <sup>2</sup>
Angle	radian	rad
Angular speed	radians per second, radians-per-square second, revolutions per minute, revolutions per second	rad/s, rad/s <sup>2</sup> , Rpm, rev/s

## Decimal multiples and parts of unit

Decimal power	Value	Prefixes	Symbol	Stands for
10 <sup>12</sup>	1000000000000	tera	T	billion times
10 <sup>9</sup>	1000000000	giga	G	thousand milliotimes
10 <sup>6</sup>	1000000	mega	M	million times
10 <sup>3</sup>	1000	kilo	K	thousand times
10 <sup>2</sup>	100	hecto	h	hundred times
10 <sup>1</sup>	10.10 <sup>1</sup>	deca	da	ten times
10 <sup>-1</sup>	0.1 10 <sup>-1</sup>	deci	d	tenth
10 <sup>-2</sup>	0.01	centi	c	hundreth
10 <sup>-3</sup>	0.001	milli	m	thousandth
10 <sup>-6</sup>	0.000001	micro	μ	millionth
10 <sup>-9</sup>	0.000000001	nano	n	thousand millionth
10 <sup>-12</sup>	0.000000000001	pico	p	billionth

# Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units

## Exercise 1.1.02

Derived units of F.P.S, C.G.S, M.K.S and SI system

S.No	Physical quantity	British units		Metric units				International units	
		FPS	Symbol	CGS	Symbol	MKS	Symbol	SI Units	Symbol
1	Area	Square foot	ft <sup>2</sup>	Square centimetre	cm <sup>2</sup>	Square metre	m <sup>2</sup>	Square metre	m <sup>2</sup>
2	Volume	Cubic foot	ft <sup>3</sup>	Cubic centimetre	cm <sup>3</sup>	Cubic metre	m <sup>3</sup>	Cubic metre	m <sup>3</sup>
3	Density	Pound per cubic foot	lb/ft <sup>3</sup>	Gram per cubic centimetre	g/cm <sup>3</sup>	Kilogram per cubic metre	kg/m <sup>3</sup>	Kilogram per cubic metre	Kg/m <sup>3</sup>
4	Speed	Foot per second	ft/s	Centimetre per second	cm/sec	Metre per second	m/sec	Metre per second	m/sec
5	Velocity (linear)	Foot per second	ft/s	Centimetre per second	cm/sec	Metre per second	m/sec	Metre per second	m/sec
6	Acceleration	Foot per square second	ft/s <sup>2</sup>	Centimetre per square second	cm/sec <sup>2</sup>	Metre per square second	m/sec <sup>2</sup>	Metre per square second	m/sec <sup>2</sup>
7	Retardation	Foot per square Second	ft/s <sup>2</sup>	Centimetre per square second	cm/sec <sup>2</sup>	Metre per square second	m/sec <sup>2</sup>	Metre square second	m/sec <sup>2</sup>
8	Angular velocity	Degree per second	Deg/sec	Radian per second	rad/sec	Radian per second	rad/sec	Radian per second	rad/sec
9	Mass	Pound (slug)	lb	Gram	g	Kilogram	kg	Kilogram	kg
10	Weight	Pound	lb	Gram	g	Kilogram weight	kg	Newton	N
11	Force	Pounds	lbf	dyne	dyn	Kilogram force	kgf	Newton	N(kgm/sec <sup>2</sup> )
12	Power	Foot pound per second	ft.lb/sec	Gram.centimetre/sec	g.cm/sec	kilogram metre per second	kg.m/sec	-	-
		Horse power	hp	Erg per second		watt	W	watt	W(J/sec)
13	Pressure, Stress	Pound per square inch	lb/in <sup>2</sup>	Gram per square centimetre	g/cm <sup>2</sup>	Kilogram per square metre	kg/m <sup>2</sup>	Newton per square metre	N/m <sup>2</sup>
14	Energy, Work	Foot.pound	ft.lb	Gram centimetre	g.cm	Kilogram metre	kg.m	joule	J(Nm)
15	Heat	British thermal unit	Btu	calorie	Cal	joule	J	joule	J(Nm)
16	Torque	Pound force foot	lbf.ft	Newton millimetre	N mm	Kilogram metre	kg.m	Newton metre	Nm
17	Temperature	Degree Fahrenheit	°F	Degree Centigrade	°C	Kelvin	K	Kelvin	K
18	Specific heat	BTU per pound degree fahrenheit	Btu/lb °F	Calorie per gram degree Celsius	Cal/g °C	Joule per kilogram kelvin	J/(kgK)	Joule per kilogram kelvin	J/(kgK)

**UNITS OF WEIGHT**

Milligram - force	1 mgf	
Gram-force	1 gf	1000 mgf
Kilogram-force	1 kgf	= 1000 gf
Tonne	1 t	= 1000 kgf
Ounce	1	= 28.35 gf
Pound	1 lbs	= 0.454 kgf
Long ton	1	= 1016 kgf
Short ton	1	= 907 kgf

**Time****TIME**

Second	1 s	
Minute	1 min	60 s
Hour	1 hr	= 60 min

**1 Centesimal unit**1 Right Angle = 100 grade (100<sup>g</sup>)1 grade (1<sup>g</sup>) = 100 Minute (100')

1 minute (1') = 100 second (100'')

**2 Sexagesimal unit**

1 Right angle = 90 Degree (90°)

1 Degree (1°) = 60 minutes (60')

1 minute (1') = 60 seconds (60'')

**3 Circular unit****Radian**

Relationship between Radian and Degree

$$1 \text{ Radian} = \frac{180^\circ}{\pi}$$

$$180^\circ = \pi \text{ Radian};$$

$$1 \text{ Degree} = \frac{\pi}{180} \text{ Radian}$$

**TEMPERATURE**

Scale	Freezing point	Boiling point
Centigrade (°C)	0°C	100°C
Fahrenheit (°F)	32°F	212°F
Kelvin (K)	273K	373K
Reaumur (°R)	0°R	80°R

**TEMPERATURE**

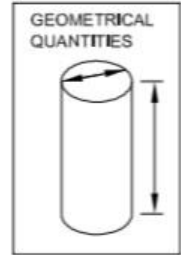
$$\frac{^\circ\text{R}}{80} = \frac{^\circ\text{C}}{100} = \frac{\text{K} - 273}{100} = \frac{^\circ\text{F} - 32}{180}$$

**SI units and the British units:**

Quantity	SI unit → British unit	British unit → SI unit
Length	1 m = 3.281 ft 1 km = 0.621 mile	1 ft = 0.3048 m 1 mile = 1.609 km
Speed	1 m/s = 3.281 ft/s 1 km/h = 0.621 mph	1 ft/s = 0.305 m/s 1 mph = 1.61 km/h
Acceleration	1 m/s <sup>2</sup> = 3.281 ft/s <sup>2</sup>	1 ft/s <sup>2</sup> = 0.305 m/s <sup>2</sup>
Mass	1 kg = 2.205 lb	1 lb = 0.454 kg
Force	1 N = 0.225 lbf	1 lbf = 4.448 N (1 million newtons)
Torque	1 Nm = 0.738 lbf ft	1 lbf ft = 1.355 Nm
Pressure	1 N/m <sup>2</sup> = 0.000145 lbf/in <sup>2</sup> 1 Pa = 1 N/m <sup>2</sup> 1 bar = 14.5038 lbf/in <sup>2</sup>	1 lbf/in <sup>2</sup> = 6.896 kN/m <sup>2</sup> 1 lbf/in <sup>2</sup> = 6.895 kN/m <sup>2</sup>
Energy, work	1 J = 0.738 ft lbf 1 J = 0.239 calorie 1 kJ = 0.948 Btu (1 therm = 100 000 Btu) 1 kJ = 0.526 CHU	1 ft lbf = 1.355 J 1 calorie = 4.186 J 1 Btu = 1.055 kJ 1 CHU = 1.9 kJ
Power	1 kW = 1.34 hp	1 hp = 0.7457 kW
Fuel consumption	1 km/L = 2.82 mile/gallon	1 mpg = 0.354 km/L
Specific fuel consumption	1 kg/kWh = 1.65 lb/bhp h 1 litre/kWh = 1.575 pt/bhp h	1 lb/bhp h = 0.606 kg/kWh 1 pt/bhp h = 0.631 litre/kWh
Calorific value	1 kJ/kg = 0.43 Btu/lb 1 kJ/kg = 0.239 CHU/lb	1 Btu/lb = 2.326 kJ/kg 1 CHU/lb = 4.188 kJ/kg

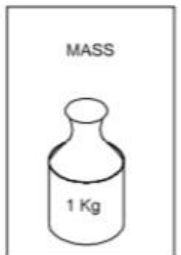
### Geometrical quantities

Symbol	Physical quantity	Conventional Units	S.I.Units	Symbol S.I. units
l	Length	m	Metre	m
h	Height	m	Metre	m
b	Width, breadth	m	Metre	m
r	Radius	m	Metre	m
d	Diameter	m	Metre	m
d,δ	Wall thickness	m	Metre	m
S	Length of path	m	Metre	m
A (S)	Area	m <sup>2</sup>	Square metre	m <sup>2</sup>
V(v)	Volume	m <sup>3</sup>	Cubic metre	m <sup>3</sup>
α,β,γ etc	Angle	°	Radian (1 rad = 57.3°)	rad
λ	Wave length	km	Kilometre	km
I, I <sub>a</sub>	Second moment of area	cm <sup>4</sup>	Metre to the fourth power	m <sup>4</sup>



### MASS

m	Mass	kg	Kilogram	kg
ρ	Density	g/cm <sup>3</sup>	Kilogram per cubicmetre	kg/m <sup>3</sup>
I, J	Moment of inertia	kg, m <sup>2</sup>	Newton metre	



### Conversion factors

1 inch	=	25.4 mm
1 mm	=	0.03937 inch
1 metre	=	39.37 inch
1 micron	=	0.00003937"
1 kilometre	=	0.621 miles
1 pound	=	453.6 gr
1 kg	=	2.205 lbs
1 metric ton	=	0.98 ton

