SYLLABUS

1st Year **Common for All Engineering Trades under CTS** **Duration: One Year**

S.no.	Syllabus	Time	Marks
I	**Unit, Fractions** 1 Classification of Unit System 2 Fundamental and Derived Units F.P.S, C.G.S, M.K.S and SI Units 3 Measurement Units and Conversion 4 Factors, HCF, LCM and Problems 5 Fractions – Addition, Subtraction, Multiplication and Division 6 Decimal Fractions - – Addition, Subtraction, Multiplication and Division 7 Solving Problems by using calculator	4	3
II	**Square Root: Ratio and Proportions, Percentage** 1 Square and Square Root 2 Simple problems using calculator 3 Application of Pythagoras Theorem and related problems 4 Ratio and Proportions 5 Direct and Indirect proportion 6 Percentage 7 Changing percentage to decimal	7	4
III	**Material Science** 1 Types of metals 2 Physical and Mechanical Properties of metals 3 Types of ferrous and non-ferrous metals 4 Introduction of iron and cast iron 5 Difference between iron and steel, alloy steel and carbon steel 6 Properties and uses of rubber, timber and insulating materials	10	5
IV	**Mass, Weight, Volume, and Density** 1 Mass, volume, density, weight & specific gravity 2 Related problems for mass, volume, density, weight & specific gravity	10	5
V	**Speed and Velocity, Work Power and Energy** 1 Rest, motion, speed, velocity, difference between speed and velocity, acceleration and retardation 2 Related problems on speed and velocity 3 Potential energy, Kinetic Energy and related problems with related problems 4 Work, power, energy, HP, IHP, BHP and efficiency	5	3

S.no.	Syllabus	Time	Marks
VI	**Heat & Temperature and Pressure** 1 Concept of heat and temperature, effects of heat, difference between heat and temperature 2 Scales of temperature, Celsius, Fahenhiet, Kelvin and Conversion between scales of temperature 3 Temperature measuring instruments, types of thermometer, pyrometer and transmission of heat - Conduction, convection and radiation 4 Co-efficient of linear expansion and related problems with assignments 5 Problem of Heat loss and heat gain with assignments 6 Thermal conductivity and insulators 7 Boiling point and melting point of different metals and Non metals 8 Concept of pressure and its units in different system	15	9
VII	**Basic Electricity** 1 Introduction and uses of electricity, molecule, atom, how electricity is produced, electric current AC, DC and their comparison, voltage , resistance and their units 2 Conductor, Insulator, types of connections- Series and Parallel, Ohm's Law, relation between VIR & related problems 3 Electrical power, energy and their units, calculation with assignments 4 Magnetic induction, self and mutual inductance and EMF generation 5 Electrical Power, HP, Energy and units of electrical energy	12	7
VIII	**Mensuration** 1 Area and perimeter of square, rectangle and parallelogram 2 Area an Perimeter of Triangle 3 Area and Perimeter of Circle, Semi-circle , circular ring, sector of circle, hexagon and ellipse 4 Surface area and Volume of solids- cube, cuboids, cylinder, sphere and hollow cylinder 5 Finding lateral surface area , total surface area and capacity in liters of hexagonal, conical and cylindrical shaped vessels	9	4
IX	**Levers and Simple Machines** 1 Simple machines, Effort and load, mechanical advantage, velocity ratio, efficiency of machine, relation between efficiency, velocity ratio and mechanical advantage 2 Lever and its types	5	3
X	**Trigonometry** 1 Measurement of Angle, Trigonometrical Ratios, Trigonometric Table 2 Trigonometry-Application in calculating height and distance (Simple Applications)	5	5
	Total	84	50

Necessity

All physical quantities are to be measured in terms of standard quantities.

Unit

A unit is defined as a standard or fixed quantity of one kind used to measure other quantities of the same kind.

Classification

Fundamental units and derived units are the two classifications.

Fundamental units

Units of basic quantities of length, mass and time.

Derived units

Units which are derived from basic units and bear a constant relationship with the fundamental units.E.g. area, volume, pressure, force etc.

Systems of units

- F.P.S system is the British system in which the basic units of length, mass and time are foot, pound and second respectively.
- C.G.S system is the metric system in which the basic units of length, mass and time are centimeter, gram and seconds respectively.
- M.K.S system is another metric system in which the basic units of length, mass and time are metre, kilogram and second respectively.
- S.I. units are referred to as Systems International units which is again of metric and the basic units, their names and symbols are as follows.

Fundamental units and derived units are the two classifications of units.

Length, mass and time are the fundamental units in all the systems (i.e) F.P.S, C.G.S, M.K.S and S.I. systems.

Example

Length: What is the length of copper wire in the roll , if the roll of copper wire weighs 8kg, the dia of wire is 0.9cm and the density is 8.9 gm/cm^3?

Solution

mass of copper wire in the roll = 8kg (or)8000grams
Dia of copper wire in the roll = 0.9cm
Density of copper wire = 8.9 gm/cm^3

Area of cross section of copper wire

$$= \frac{\pi d^2}{4} = \frac{\pi \times (0.9^2)}{4} = 0.636 cm^2$$

Volume of copper wire

$$= \frac{\text{Mass of copper wire}}{\text{Density of copper wire}} = \frac{8000 \text{grams}}{8.9 \text{ gm/cm}^3} = 898.88 \text{cm}^3$$

Length of copper wire

$$= \frac{\text{Volume of copper wire}}{\text{Area of cross section of copper wire}} = \frac{898.88 \text{cm}^3}{0.636 \text{cm}^2}$$

$$= 1413.33 \text{ cm}$$

Length of copper wire =1413cm.

Time: The S.I. unit of time, the second, is another base units of S.I., it is defined as the time interval occupied by a number of cycles of radiation from the calcium atom. The second is the same quantity in the S.I. in the British and in the U.S. systems of units.

Fundamental units of F.P.S, C.G.S, M.K.S and S.I

S.No.	Basic quantity	British units		Metric units				International units	
		F.P.S	Symbol	C.G.S	Symbol	M.K.S	Symbol	S.I Units	Symbol
1	Length	Foot	ft	Centimetre	cm	Metre	m	Metre	m
2	Mass	Pound	lb	Gram	g	Kilogram	kg	Kilogram	Kg
3	Time	Second	s	Second	s	Second	s	Second	s
4	Current	Ampere	A	Ampere	A	Ampere	A	Ampere	A
5	Temperature	Fahrenheit	°F	Centigrade	°C	Centigrade	°C	Kelvin	K
6	Light intensity	Candela	Cd	Candela	Cd	Candela	Cd	Candela	Cd

Unit - 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^2	Square centimetre	cm^2	Square metre	m^2	Square metre	m^2
2	Volume	Cubic foot	ft^3	Cubic centimetre	cm^3	Cubic metre	m^3	Cubic metre	m^3
3	Density	Pound per cubic foot	lb/ft^3	Gram per cubic centimetre	g/cm^3	Kilogram per cubic metre	kg/m^3	Kilogram per cubic metre	Kg/m^3
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^2	Centimetre per square second	cm/sec^2	Metre per square second	m/sec^2	Metre per square second	m/sec^2
7	Retardation	Foot per square Second	ft/s^2	Centimetre per square second	cm/sec^2	Metre per square second	m/sec^2	Metre square second	m/sec^2
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	$N(kgm/sec^2)$
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^2	Gram per square centimetre	g/cm^2	Kilogram per square metre	kg/m^2	Newton per square metre	N/m^2
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)

S.No	Physical quantity	British units		Metric units				International units	
		FPS	Symbol	CGS	Symbol	MKS	Symbol	SI Units	Symbol
19	Frequency	Cycle per second	1/s	Hertz	Hz	Hertz	Hz	Hertz	Hz
20	Moment of inertia	Pound force foot square second	$lbf.ft.s^2$	Gram square centimetre	$g.cm^2$	Kilogram square metre	$kg.m^2$	Kilogram square metre	$Kg.m^2$
21	Momentum	Pound second	lb.s	Gram centimetre per second	g.cm/sec	Kilogram metre per second	kg.m/sec	Kilogram metre per second	Kg.m/ sec
22	Moment of force	Pounds foot	lbs.ft	Gram centimetre	g.cm	Kilogram metre	kg.m	Newton metre	Nm
23	Angle	degree	deg	degree	deg	degree	deg	Radian	rad
24	Specific volume	Cubic foot per pound	ft^3/lbs	Cubic centimetre per gram	Cm^3/g	Cubic metre per kilogram	m^3/kg	Cubic metre per kilogram	m^3/kg
25	Specific resistance	Ohm foot	Ω ft	Ohm centimetre	Ω cm	Ohm meter	Ω m	Ohm meter	Ω m
26	Specific weight	Pound per cubic foot	lbf/ft^3	Gram per cubic centimetre	g/cm^3	Kilogram per cubic metre	kg/m^3	Newton per cubic metre	N/m^3
27	Fuel consumption	Miles per gallon	m/gal	Centimetre per cubic centimetre	cm/cm^3	Kilometre per litre	km/l	Metre per cubic metre	m/m^3
28	Dynamic viscosity	Pound force per square foot	lbf/ft^2	Centi poise	cP	pascal second	$P_{a.s}$	pascal second	$P_{a.s}$
29	Surface tension	Poundal per foot	pdl/ft	dyne per centimetre	dyn/cm	Newton per metre	N/m	Newton per metre	N/m
30	Entropy	British thermal unit per degree Fahrenheit	$Btu/^0F$	Calorie per degree centigrade	$Cal/^0c$	Joule per kelvin	J/K	Joule per kelvin	J/K
31	Electric current	Columb per second	C/s	Biot	Bi	Ampere	A	Ampere	A
32	Electric voltage	Volt	V	Volt	V	Volt	V	Volt	V
33	Electric resistance	Ohm	Ω	Ohm	Ω	Ohm	Ω	Ohm	Ω, (V/A)
34	Electric conductance	Mho, Siemens	ʊ,s	Mho	ʊ,s	Siemens	s	Siemens	s
35	Light intensity	Candela	Cd	Candela	Cd	Candela	Cd	Candela	Cd
36	Specific gravity	No unit	-	No unit	-	No unit	-	No unit	-

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^2
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^2 kN/m^2
Angle	radian	rad
Angular speed	radians per second radians-per-square second revolutions per minute revolutions per second	rad/s rad/s^2 Rpm rev/s

Decimal multiples and parts of unit

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

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^2 = 3.281 ft/s^2	1 ft/s^2 = 0.305 m/s^2
Mass	1 kg = 2.205 lb	1 lb = 0.454 kg
Force	1 N = 0.225 lbf 1 MN	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^2 = 0.000145 lbf/in^2 1 Pa = 1 N/m^2 1 bar = 14.5038 lbf/in^2	1 lbf/in^2 = 6.896 kN/m^2 1 lbf/in^2 = 6.895 kN/m^2
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	1km/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

Units in measuring practice with definitions

Quantity		Unit		Explanation
Force	F	Newton	N	1 Newton is equal to the force which imports an acceleration of $1 m/s^2$ to a body of mass 1 kg $1N = 1 kg\ m/s^2$
Pressure	P	Newton per square metre	$\frac{N}{m^2}$	1 Newton per square metre (1 pascal) is equal to the pressure with which the force of 1 N is exercised perpendicular to the area of $1 m^2$
		Pascal	Pa	$1Pa = 1 N/m^2$. 1 Bar (bar) is the special name for 100 000 Pa.
Normal stress tensile or compressive stress, Shear stress		Newton per square metre	$\frac{N}{m^2}$	1 Newton per square metre (1 pascal) to the mechanical stress with which the force of 1 n is exercised on the area of $1 m^2$. In many branches of engineering the mechanical stress and strength are specified in N/m^2. $1 N/m^2 = 1000\ 000 Pa = 1 MPa$
Heat Energy Quantity of heat	W	Joule	J	1 Joule is equal to the work that is done when the point of application of the force of 1 N is shifted by 1 m in the direction of the force. $1 J = 1 Nm = 1 Ws = 1 kgm^2/s^2$ $3600\ 000 J = 1 kWh$
Moment of a force (torque)	M	Newton metre	Nm	1 Newton is equal to the moment of a force which results from the product of the force
		joule	J	of 1 N and the lever arm of 1 m. $1 Nm = 1 J = 1 Ws = 1 kgm^2/s^2$
Power Energy flow	P	Watt	W	1 Watt is equal to the power with which the energy of 1 J is converted during the time of 1s.
Heat flow	ø			The unit watt is also called volt ampere in the specification of apparent electric power $1 W = 1 J/s = 1 Nm\ s = 1 VA$
Specific heat value	Hμ	Joule per kilogram	$\frac{J}{kg}$	1 Joule per kilogram is equal to the quantity of heat which on complete burning of the mass of 1 kg releases the energy of 1 J
Fuel consumption	P	gram per kilowatt-hour	$\frac{g}{kwh}$	1 gram per kilowatt-hour is equal to the fuel consumption of the mass of 1 g for the work of 1 kWh.
Temperature	T	Kelvin	K	The kelvin is defined as the fraction $\frac{1}{273.16}$ of the thermodynamic temperature of the triple point of water.
Electric current	I	Ampere	A	1 Ampere is the strength of a current which would bring about an electrodynamic force of 0.2.10 N per 1 m length between two parallel conductors placed at a distance of 1 m.

Electric voltage	V	Volt	V	1 Volt is equal to the electric voltage between two points of a metallic conductor in which a power of 1 W is expended for a current of 1 A strength.
Electric resistance	R	Ohm	Ω	1 Ohm is equal to the electric resistance between two points of a metallic conductor in which an electric current of 1 A flows at a voltage of 1 V.
Electric conductance	G	Siemens	S	1 Siemens is equal to the electric conductance of a conductor of electric resistance of 1ohm
Quantity of electricity	Q	Coulomb ampere-second	C As	1 Coulomb is equal to the quantity of electricity which flows through the conductor cross-section during the time of 1 s at an electric current of 1A.

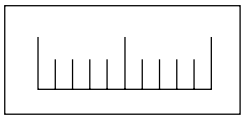
Prefixes for decimal multiples and submultiples

Use		
1 Megapascal	= 1 MPa	= 1000000 Pa
1 Kilowatt	= 1 kW	= 1000 W
1 Hectolitre	= 1 hL	= 100 L
Decanewton	= 1 daN	= 10 N
Decimetre	= 1 dm	= 0.1 m
1 Centimetre	= 1 cm	= 0.01 m
1 Millimetre	= 1 mm	= 0.001 m
1 Micrometre	= 1 um	= 0.000001 m

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

Units of physical quantities

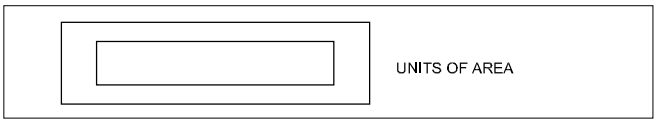


UNITS OF LENGTH

Units of length

Micron	1 μ	=	0.001 mm
Millimetre	1 mm	=	1000 μ
Centimetre	1 cm	=	10 mm
Decimetre	1 dm	=	10 cm
Metre	1 m	=	10 dm
Kilometre	1 km	=	1000 m
Inch	1"	=	25.4 mm
Foot	1"	=	0.305 m
Yard	1 Yd	=	0.914 m
Nautical mile	1 NM	=	1852 m
Geographical mile	1	=	1855.4 m

Units of area



Square millimetre	1 mm^2	
Square centimetre	1 cm^2	= 100 mm^2
Square decimetre	1 dm^2	= 100 cm^2
Square metre	1 m^2	= 100 dm^2
Are	1 a	= 100 m^2
Hectare	1 ha	= 100 a
Square kilometre	1 km^2	= 100 ha
Square inch	1 sq.in	= 6.45 cm^2
Square foot	1 sq.ft	= 0.093 m^2
Square yard	1 sq.yd	= 0.84 m^2
Square metre	1 m^2	= 10.76 ft^2
Acre	1	= 40.5 a

1 Acre = 100 cent

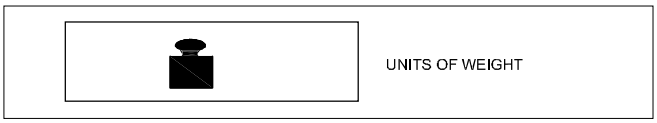
1 Cent = 436 Sq. ft.
1 Ground = 2400 Sq.ft.

1 Hectare = 2.47 acres

1 acre = 0.4047 Hectare

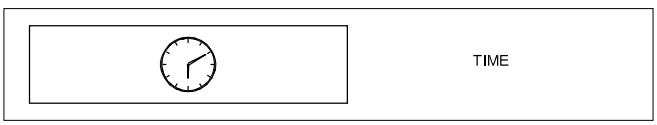
1 Hectare = 10000 sq. metre

Units of weight

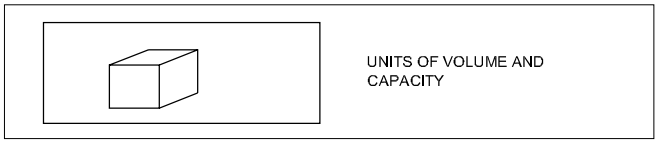


Milligram - force	1 mgf	
Gram-force	1 gf	1000 mgf
Kilogram-force	1 kgf	= 1000 gf
Tonne	1 t	= 1000 kgf
Ounce	1	= 28.35 gf
Pound	1 lbs	= 0.454 kgf
Long ton	1	= 1016 kgf
Short ton	1	= 907 kgf

Time



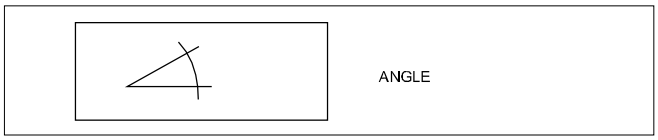
Second	1 s	
Minute	1 min	60 s
Hour	1 hr	= 60 min



Units of volume and capacity

Cubic millimetre	1 mm^3	
Cubic centimetre	1 cm^3	= 1000 mm^3
Cubic decimetre	1 dm^3	= 1000 cm^3
Cubic metre	1 m^3	= 1000 dm^3
Litre	1 l	= 1 dm^3
Hectolitre	1 hl	= 100 l
Cubic inch	1 cu. in	= 16.387 cm^3
Cubic foot	1 cu. ft	= 28317 cm^3
Gallon (British)	1 gal	= 4.54 l
1cubic metre	1 m^3	= 1000 litres
1000 Cu.cm	1000 cm^3	= 1 litre
1 cubic foot	1 ft^3	= 6.25 Gallon
1 litre	1lt	= 0.22 Gallon

Angle



1 **Centessimal unit**

1 Right Angle = 100 grade (100^g)

1 grade (1^g) = 100 Minute (100')

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

2 Sexagesimal unit

1 Right angle	= 90 Degree (90°)
1 Degree (1°)	= 60 minutes (60')
1minute (1')	= 60 seconds (60")

3 Circular unit

Radian

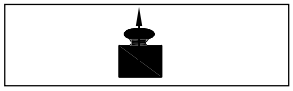
Relationship between Radian and Degree

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

180^0 = π Radian;

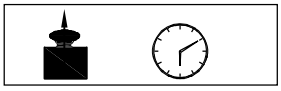
1 Degree = $\frac{\pi}{180}$ Radian

Work



Kilogram-force	1 kgfm	= 9.80665 J
Metre	1 kgfm	= 9.80665 Ws
Joule	1 J	= 1 Nm
Watt-second	1 Ws	= 0.102 kgfm
Kilowatt hour	1 kWh	= 3.6×10^6 J
		= 859.8456 $kcal_{IT}$
I.T.Kilocalorie	1 $kcal_{IT}$	= 426.kgfm

Power



Kilogram-force metre/second

1 kgfm/s	= 9.80665 W
Kilowatt	1 kW = 1000 W = 1000 J/s
	= 102 kgfm/s (approx.)
Metric horse power	1 HP = 75 kgfm/s
	= 0.736 kW
1 Calorie	= 4.187J

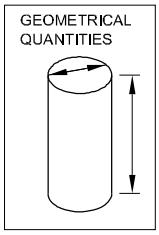
I.T.Kilocalorie/hour = 1 $kcal_{IT/h}$ = 1.163 W

Pressure

Pascal	1 Pa	= 1 N/m^2	1 atm	= 101325 Pa
Bar	1 bar = $10N/cm^2$	= 100000 Pa–Torr	1 torr	= $\frac{101325}{760}$ ≈ 133.32 pa
Atmosphere	1 atm	= 1 kgf/cm^2	1 kgf/cm^2 = 735.6 mm of mercury	

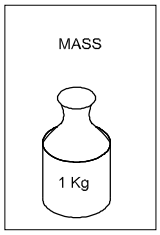
Geometrical quantities

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^2	Square metre	m^2
V (v)	Volume	m^3	Cubic metre	m^3
α,β,γ etc	Angle	°	Radian (1 rad = 57.3°)	rad
λ	Wave length	km	Kilometre	km
I,Ia	Second moment of area	cm^4	Metre to the fourthpower	m^4



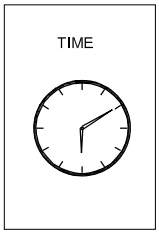
MASS

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



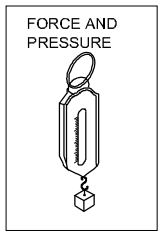
TIME

T	Time or time interval	s	Second	s
nu	Rotational frequency	l/min	Reciprocal second	l/s
u,v,w,c	Velocity speed	m/min	Metre per second	m/s
ω	Angular velocity	rad/s	Radian per second	rad/s
g	Acceleration of freefall	m/s^2	Metre per second square	m/s^2
a	Acceleration	m/s^2	Metre per second square	m/s^2
	Retardation	m/s^2	Metre per second square	m/s^2



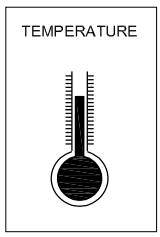
FORCE AND PRESSURE

F	Force	kgf	Newton (1kgf = 9.80665N)	N
G(P,W)	Weight	kgf	Newton	N
γ	Specific weight	kgf/m^3	Newton per cubic metre	N/m^3
M	Moment of force (force x distance)	kgf.m	Newton metre	N.m
p	Pressure (force/ area)	kgf/cm^2	pascal, Newton per square metre	$Pa,N/m^2$
p	Normal stress	kgf/mm^2	bar (1 bar = 10 N/m)	
τ p	Shear stress	kgf/mm^2	bar	
E	Modulus of elasticity	kgf/mm^2	Newton per square metre	N/m^2
G	Shear modulus	kgf/mm^2	Newton per square metre	N/m^2
μ	Co-efficient of friction	No Unit		



TEMPERATURE

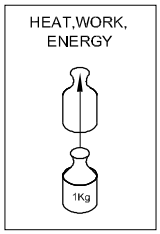
Scale	Freezing point	Boiling point
Centigrade (˚C)	0°C	100°C
Fahrenheit (°F)	32°F	212°F
Kelvin (K)	273K	373K
Reaumur (°R)	0°R	80°R



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

HEAT, WORK, ENERGY,FORCE

A,W	Work	kgfm	Joule (1 Joule=1 N.m)	J (Nm)
P	Power	kgfm/s	Watt	W (J/s)
E,W	Energy	kgfm	Joule	J (Nm)
η	Efficiency	-	-	-
W,A,E,Q	Quantity of heat	kcal	Joule	J
C	Specific heat	kcal/kgf°C	Joule per newton per degree Kelvin	J/N.°K
	Thermal conductivity	kcal/mh°C	Joule per metre per second per degree Kelvin	J/ms°K



Force In C.G.S. System : Force (Dyne) = Mass (gm)XAcceleration (cm/sec^2)

In F.P.S. System : Force (Poundal) = Mass (lb) X Acceleration (ft./sec^2)

In M.K.S System : Force (Newton) = Mass (Kg) x Acceleration (mtr./sec^2)

1 Dyne = 1 gm x1 cm/sec^2

1 Poundal = 1 lb x 1 ft/sec^2

1 Newton = 1 kg x 1 mtr/sec^2 = 10^5 dynes

1gm weight = 981 Dynes

1 lb weight = 32 Poundals

1 kg weight = 9.81 Newtons

ELECTRICAL QUANTITIES

V	Electric potential	V	Volt	V(W/A)
E	Electromotive force	V	Volt	V(W/A)
I	Electric current	A	Ampere	A
R	Electric resistance	Ω	Ohm	Ω (V/A)
e	Specific resistance	Ω m	Ohm metre	Vm/A
G	Conductance	Ω^{-1}	Siemens	S

Assignment - Conversions of length, mass, force, work, power amd energy

1 Convert the following as indicated

a 5 yards into metres _____

b 15 miles into kilometres _____

c 7 metres into yards _____

d 320 kilometres into miles _____

2 Convert

a 5 pounds into kilograms _____

b 8.5 kilograms into pounds _____

c 5 ounces into grams _____

d 16 tons into kilograms _____

3 Convert

a 40 inches into centimetres _____

b 12 feet into metres _____

c 5 metres into inches _____

d 8 metres into feet _____

4 Convert

a 234 cubic metres into gallons _____

b 2 cubic feet into litres _____

c 2.5 gallons into litres _____

d 5 litres into gallons _____

5 Answer the following questions

a 120°C = _____ °F.

b 8 mm = _____ inches

12 mm = _____ inches

6 Convert and find out

A car consumes fuel at the rate of one gallon for a travel of 40 miles.

The same car travels a distance of 120 kilometer. what is the consumption of fuel in litres.

7 Write equivalent British units for the given metric units

a Seconds, minutes, Hours

b Grams, Kilograms

c Litres, Cubic meters

d Square centimeter, Square kilometer

8 Expand the abbreviations of the following

a km/l

b N/m^2

c KW

d m/s^2

e RPM

9 Convert the following S.I. units as required.

a Length

i 3.4 m = _____ mm

ii 1.2 m = _____ cm

iii 0.8 m = _____ mm

iv 0.02 km = _____ cm

v 10.2 km = _____ mile

vi 6 m = _____ km

vii 18 m = _____ mm

viii 450 m = _____ km

ix 85 cm = _____ km

x 0.06 km = _____ mm

b Mass

i 650 g = _____ kg

ii 300 cg = _____ g

iii 8 g = _____ dg

iv 120 mg = _____ g

v 8 dag = _____ mg

vi 2.5 g = _____ mg

vii 2.5 g = _____ kg

viii 20 cg = _____ mg

ix 0.05 Mt = _____ kg

c Force

i 1.2 N = _____ kg

ii 2.6 N = _____ kg

iii 800 N = _____ KN

iv 14.5 kg = _____ N

v 25 kg = _____ N

d Work, energy, amount of heat

i 2 Nm = _____ Ncm

ii 50 Ncm = _____ Nm

iii 120 KJ = _____ J

iv 40 J = _____ KJ

v 300 wh = _____ kwh

e Power

i 200 mW = _____ W

ii 0.2 kW = _____ W

iii 300 kW = _____ mW

iv 2.10^{6} W = _____ mW

v 6.10^{-4} kW = _____ W

vi 2 W = _____ KW

vii 350 W = _____ kW

viii 0.08 W = _____ kW

ix 2×10^{-3} kW =_____ W

x 0.04 W = _____ mW

f Convert as required.

i 3 Nm = _____ J

ii 2 J = _____ Ws

iii 12 J = _____ KJ

iv 3 Nm/s = _____ J/s

v 5 N = _____ KN

vi 3 KJ = _____ Nm

vii 18 J/s = _____ W

viii 12 W = _____ J/s

ix kJ/s = _____ Nm/s

Prime Numbers and whole Numbers

Factor

A factor is a small number which divides exactly into a bigger number.e.g.

To find the factors of 24, 72, 100 numbers

24 = 2 x 2 x 2 x 3

72 = 2 x 2 x 2 x 3 x 3

100 = 2 x 2 x 5 x 5

The numbers 2,3,5 are called factors.

Definition of a prime factor

Prime factor is a number which divides a prime number into factors.e.g.

57 = 3 x 19

The numbers 3 and 19 are prime factors.

They are called as such, since 3 & 19 also belong to prime number category.

Definition of H.C.F

The Highest Common Factor

The H.C.F of a given group of numbers is the highest number which will exactly divide all the numbers of that group.e.g.

To find the H.C.F of the numbers 24, 72, 100

24 = 2 x 2 x 2 x 3

72 = 2 x 2 x 2 x 3 x 3

100 = 2 x 2 x 5 x 5

The factors common to all the three numbers are

2 x 2 = 4. So HCF = 4.

Definition of L.C.M

Lowest common multiple

The lowest common multiple of a group of numbers is the smallest number that will contain each number of the given group without a remainder.e.g.

- Factorise the following numbers

  7,17,20,66,128

  7,17 - These two belong to Prime numbers. Hence no factor except unity and itself.

Factors of 20 = 2 x 2 x 5

2	20
2	10
	5

Factors of 66 = 2 x 3 x 11

2	66
3	33
	11

Factors of 128 = 2 x 2 x 2 x 2 x 2 x 2 x 2

2	128
2	64
2	32
2	16
2	8
2	4
	2

- Select prime numbers from 3 to 29

  3,5,7,11,13,17,19,23,29

- Find the HCF of the following group of numbers HCF of 78, 128, 196

  78 = 2 x 3 x 13

2	78
3	39
	13

128 = 2 x 2 x 2 x 2 x 2 x 2 x 2

2	128
2	64
2	32
2	16
2	8
2	4
	2

196 = 2 x 2 x 49

2	196
2	98
	49

HCF = 2

- Find LCM of 84,92,76

LCM =

2	84, 92, 76
2	42, 46, 38
3	21, 23, 19
	7, 23, 19

LCM = 2 x 2 x 3 x 7 x 23 x 19 = 36708

- To find out the LCM of 36, 108, 60

2	36, 108, 60
2	18, 54, 30
3	9, 27, 15
3	3, 9, 5
	1, 3, 5

LCM of the number

36, 108, 60 = 2 x 2 x 3 x 3 x 3 x 5 = 540

The necessity of finding LCM and HCF arises in subtraction and addition of fractions.

Description

A minimal quantity that is not a whole number. For e.g. .

$\frac{1}{5}$ A vulgur fraction consists of a numerator and denominator.

Numerator/Denominator

The number above the line in a vulgar fraction showing how many of the parts indicated by the denominator are taken is the numerator. The total number of parts into which the whole quantity is divided and written below the line in a vulgar fraction is the denominator. e.g.

$\frac{1}{4}, \frac{3}{4}, \frac{7}{12}$

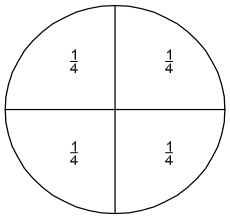
1,3,7 - numerators 4,12 - denominators

Fraction: Concept

Every number can be represented as a fraction.e.g.

$1\frac{1}{4} = \frac{5}{4}$, A full number can be represented as an apparent fraction.e.g. (Fig 1)

Fig 1



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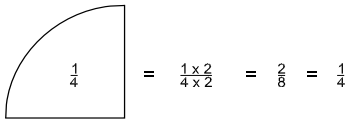
Fraction: Value

The value of a fraction remains the same if the numerator and denominator of the fraction are multiplied or divided by the same number.(Fig 2)

Fig 2



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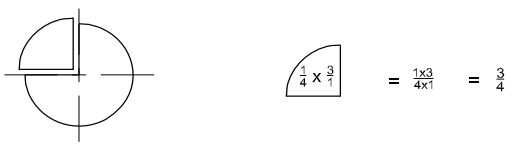
Multiplication

When fractions are to be multiplied, multiply all the numerators to get the numerator of the product and multiply all the denominators to form the denominator of the product. (Fig 3)

Fig 3



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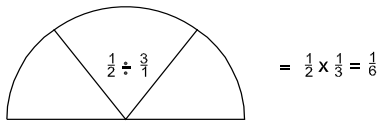
Division

When a fraction is divided by another fraction the dividend is multiplied by the reciprocal of the divisor. (Fig 4)

Fig 4



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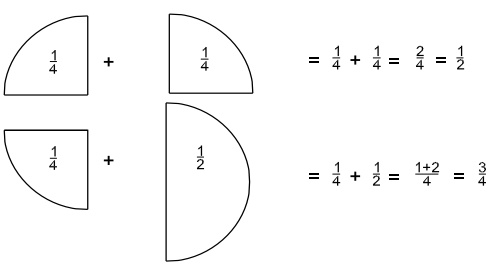
Addition and Subtraction

The denominators of the fractions should be the same when adding or subtracting the fractions. Unequal denominators must first be formed into a common denominator. It is the lowest common denominator and it is equal to the product of the most common prime numbers of the denominators of the fractions in question.(Fig 5)

Fig 5



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Examples

- Multiply $\frac{3}{4}$ by $\frac{2}{3}$,

$$\frac{3}{4} \times \frac{2}{3} = \frac{6}{12} = \frac{1}{2}$$

- Divide $\frac{3}{8}$ by $\frac{3}{4}$,

$$\frac{3}{8} \div \frac{3}{4} = \frac{3}{8} \times \frac{4}{3} = \frac{1}{2}$$

- Add $\frac{3}{4}$ and $\frac{2}{3}$,

$$\frac{3}{4} + \frac{2}{3} = \frac{9}{12} + \frac{8}{12} = \frac{17}{12} = 1\frac{5}{12}$$

- sub $\frac{7}{16}$ from $\frac{17}{32}$

$$\frac{17}{32} - \frac{7}{16} = \frac{17}{32} - \frac{14}{32} = \frac{(17-14)}{32} = \frac{3}{32}$$

Types of fractions

- Proper fractions are less than unity. Improper fractions have their numerators greater than the denominators.
- A mixed number has a full number and a fraction.

Addition of fraction

$$\text{Add}\frac{1}{2}+\frac{1}{8}+\frac{5}{12}$$

To add these fractions we have to find out L.C.M of denominators 2,8,12.

Find L.C.M of 2,8,12

Step 1 L.C.M

2	2,8,12
2	1,4,6
	1,2,3

Factors are 2,2,2,3

Hence L.C.M = 2 x 2 x 2 x 3 = 24

Step 2

$$\frac{1}{2}+\frac{1}{8}+\frac{5}{12}=\frac{12}{24}+\frac{3}{24}+\frac{10}{24}$$
$$=\frac{12+3+10}{24}=\frac{25}{24}=1\frac{1}{24}.$$

Subtraction of fraction

$$\text{subtract } 9\frac{15}{32}\text{ from }17\frac{9}{16}\text{ or}\left(17\frac{9}{16}-9\frac{15}{32}\right)$$

Step 1: Subtract whole number first 17 - 9 = 8

Step 2: L.C.M of 16,32 = 32

Since number 16 divides the number 32

$$\text{Subtracting fractions} = \frac{3}{32}$$

Adding with whole number from Step 1

$$\text{we get } 8+\frac{3}{32}=8\frac{3}{32}$$

Common fractions

Problems with plus and minus sign

Example

$$\text{solve } 3\frac{3}{4}+6\frac{7}{8}-4\frac{5}{16}-\frac{9}{32}$$

Rule to be followed

1 Add all whole numbers

2 add all + Numbers

3 Add all - Numbers

4 Find L.C.M of all denominators

Solution

Step 1: Add whole numbers = 3 + 6 - 4 = 5

Step 2: Add fractions = $\frac{3}{4}+\frac{7}{8}-\frac{5}{16}-\frac{9}{32}$

L.C.M of 4,8,16,32 is 32

$$\frac{24+28-10-9}{32}$$
$$=\frac{52-19}{32}$$
$$=\frac{33}{32}=1\frac{1}{32}$$

Step 3: Adding again with the whole number

$$\text{we get } 5+1\frac{3}{32}=6\frac{3}{32}$$

Examples

Common fractions

- Multiply

  a $\frac{3}{8}\text{by}\frac{4}{7}=\frac{3}{8}\text{x}\frac{4}{7}=\frac{3}{14}$ b $\frac{2}{3}\text{x}\frac{3}{4}\text{x}\frac{5}{8}=\frac{5}{16}$

- Division

  a $\frac{5}{16}\div\frac{5}{32}=\frac{5}{16}\text{x}\frac{32}{5}=2$

  b $4\frac{2}{3}\div3\frac{1}{7}=\frac{14}{3}\div\frac{22}{7}=\frac{14}{3}\text{x}\frac{7}{22}=\frac{49}{33}=1\frac{16}{33}$

- Addition

  $\frac{1}{2}+\frac{1}{4}+\frac{1}{8}$

  L..C.M $= 2,4,8 = 8$

  $\frac{1}{2}+\frac{1}{4}+\frac{1}{8}=\frac{4+2+1}{8}=\frac{7}{8}$

- Subraction

$$5\frac{1}{4}-3\frac{3}{4}=5-3+\frac{1}{4}-\frac{3}{4}$$
$$=2+\frac{1}{4}-\frac{3}{4}=2\frac{1}{4}-\frac{3}{4}$$
$$=\frac{9}{4}-\frac{3}{4}=\frac{9-3}{4}$$
$$=\frac{6}{4}=\frac{3}{2}=1\frac{1}{2}$$

Decimal fractions - Addition, subtraction, multilipication & division

Exercise 1.1.06

Description

Decimal fraction is a fraction whose denominator is 10 or powers of 10 or multiples of 10 (i.e.) 10, 100, 1000, 10000 etc. Meaning of a decimal number:-

12.3256 means

$$(1 \text{ X } 10) + (2 \text{ X } 1) + \frac{3}{10} + \frac{2}{100} + \frac{5}{1000} + \frac{6}{10000}$$

Representation

The denominator is omitted. A decimal point is placed at different positions of the number corresponding to the magnitude of the denominator

$$Ex. \frac{5}{10} = 0.5, \frac{35}{100} = 0.35 \frac{127}{10000} = 0.0127, \frac{3648}{1000} = 3.648$$

Addition and subtraction

Arrange the decimal fractions in a vertical order, placing the decimal point of each fraction to be added or subtracted, in succession one below the other, so that all the decimal points are arranged in a straight line. Add or subtract as you would do for a whole number and place the decimal point in the answer below the column of decimal points.

Decimal fractions less than 1 are written with a zero before the decimal point. Example: 45/100 = 0.45 (and not simply .45)

Add 0.375 + 3.686

$$\begin{array}{r} 0.375 \\ 3.686 \\ \hline 4.061 \\ \hline \end{array}$$

Subtract 18.72 from 22.61

$$\begin{array}{r} 22.61 \\ 18.72 \\ \hline 3.89 \\ \hline \end{array}$$

Multiplication

Ignore the decimal points and multiply as whole numbers. Find the total number of digits to the right of the decimal point. Insert the decimal point in the answer such that the number of digits to the right of the decimal point equals to the sum of the digits found to the right of the decimal points in the problem.

Multiply 2.5 by 1.25

= 25 x 125 = 3125. The sum of the figures to the right of decimal point is 3. Hence the answer is 3.125.

Division

Move the decimal point of the divisor to the right to make it a full number. Move the decimal point in the dividend to the same number of places, adding zeroes if necessary. Then divide.

Divide 0.75 by 0.25

$$0.25\overline{)0.75}$$

$$\frac{0.75}{0.25} \text{x} \frac{100}{100} = \frac{75}{25}$$

$$25\overline{)75} = 3$$

Move the decimal point in the multiplicand to the right to one place if the multiplier is 10, and to two places if the multiplier is 100 and so on. When dividing by 10 move the decimal point one place to the left, and, if it is by 100, move them point by two places and so on.

Example

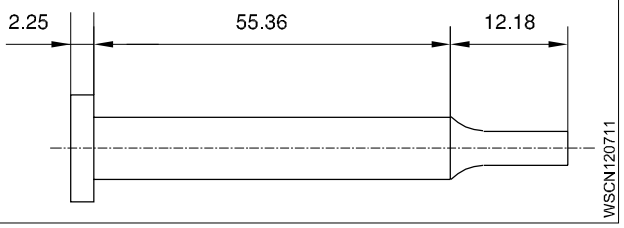
Allowing 3 mm for cutting off each pin how many pins, can be made from a 900 mm long bar? How much material will be left out?

Length of pin

= 2.25 + 55.36 + 12.18

= 69.79 mm

Fig 1



Length of the bar = 900 mm

Step 1

Let the number of pins to be made = x

Length of x number of pins = x x 69.79 mm

Step 2

Waste for each pin = 3 mm

Waste for x number of pins = 3 x x mm=3x mm

Adding step (1) + step (2) and equating to length of bar 69.79x mm + 3x mm = 900 mm

x (69.79mm + 3mm) = 900mm

x (72.79mm) = 900mm

x = 900 ÷ 72.79

Hence Number of pins to be made = 12

Secondly

Left out materials

= Total length of bar - Length for 12 pins+ wastage of cutting

= 900mm - (12 x 69.79 + 12 x 3)mm

= 900 - (837.48 + 36)mm

= 900 - 873.48mm

=26.52mm

Left out material 26.52 mm

Conversion of Decimals into fractions and vice-versa

- Convert decimal into fractions

Example

Convert 0.375 to a fraction

Now place 1 under the decimal point followed by as many zeros as there are numbers

$$0.375 = \frac{375}{1000} = \frac{15}{40} = \frac{3}{8}$$

$$0.375 = \frac{3}{8}$$

- Convert fraction into decimal

Example

- Convert $\frac{9}{16}$ to a decimal

Proceed to divide $\frac{9}{16}$ in the normal way of division but put zeros (as required) after the number 9 (Numerator)

$$\begin{array}{r} 0.5625 \\ 16\overline{)90000} \\ 80 \\ \hline 100 \\ 96 \\ \hline 40 \\ 32 \\ \hline 80 \\ 80 \\ \hline 0 \end{array}$$

$\frac{9}{16} = 0.5625$

- Convert to a decimal

$$\begin{array}{r} 0.875 \\ 8\overline{)7000} \\ 64 \\ \hline 60 \\ 56 \\ \hline 40 \\ 40 \\ \hline 0 \end{array}$$

$\frac{7}{8} = 0.875$

Recurring decimals

While converting from fraction to decimals, some fractions can be divided exactly into a decimal. In some fractions the quotient will not stop. It will continue and keep recurring. These are called recurring decimals.

Examples

- convert $\frac{1}{3}, \frac{2}{3}, \frac{1}{7}$

a $\frac{1}{3} = \frac{10000}{3} = 0.3333 - \text{Recurring}$

b $\frac{2}{3} = \frac{20000}{3} = 0.666 - \text{Recurring}$

c $\left(\frac{1}{7} = \frac{10000}{7} = 0.1428571\,42 - \text{Recurring}\right)$

These are written as below with a dot over the figure

$0.3333 \longrightarrow 0.\dot{3}$

$0.6666 \longrightarrow 0.\dot{6}$

$0.14857142 \longrightarrow 0.\dot{1}4857\dot{1}$

Note the dots marked over numbers.

We normally carry the decimal points upto 4 places in Engineering calculations.

Approximations in Measured Value calculations

In Measured Value calculations 4 places of decimals are sufficient and in many dimensions of parts even 3 decimal places are near enough to complete the maintenance job operations.

Method of writing approximations in decimals

1.73556 = 1.7356 Correct to 4 decimal places
5.7343 = 5.734 Correct to 3 decimal places
0.9345 = 0.94 Correct to 2 decimal places

Multiplication and division by 10,100,1000

Multiplying decimals by 10

A decimal fraction can be multiplied by 10,100,1000 and so on by moving the decimal point to the right by as many places as there are zeros in the multiplier.

- 4.645 x 10 = 46.45 (one place)
- 4.645 x 100 = 464.5 (two places)
- 4.645 x 1000 = 4645 (three places)

Dividing decimals by 10

A decimal fraction can be divided by 10,100,1000 and so on, by moving the decimal point to the left by as many places as required in the divisor by putting zeros

Examples

- 3.732 ÷ 10 = 0.3732 (one place)
- 3.732 ÷ 100 = 0.03732 (two places)
- 3.732 ÷ 1000 = 0.003732 (three places)

Examples

- Rewrite the following number as a fraction

  453.273

  453.273

$$= (4\times100)+(5\times10)+(3\times1)+\frac{2}{10}+\frac{7}{100}+\frac{3}{100}$$

$$= 453\frac{273}{1000}$$

- Write the representation of decimal places in the given number 0.386

  3 - Ist decimal place
  8 - IInd decimal place
  6 - IIIrd decimal place

- Write approximations in the following decimals to 3 places.

  a 6.9453 ——> 6.945

  b 8.7456 ——> 8.746

- Convert fraction to decimal

$$\frac{21}{24}=\frac{7}{8}=0.875$$

- Convert decimal to fraction

$$0.0625=\frac{625}{10000}=\frac{5}{80}=\frac{1}{16}$$

ASSIGNMENT

1 Write down the following decimal numbers in the expanded form.

  a 514.726

  b 902.524

2 Write the following decimal numbers from the expansion.

  a $500+70+5+\frac{3}{10}+\frac{2}{100}+\frac{9}{1000}$

  b $200+9+\frac{1}{10}+\frac{3}{100}+\frac{5}{1000}$

3 Convert the following decimals into fractions in the simplest form.

  a 0.72

  b 5.45

  c 3.64

  d 2.05

4 Convert the following fraction into decimals

  a $\frac{3}{5}$

  b $\frac{10}{4}$

  c $24\frac{54}{1000}$

  d $\frac{12}{25}$

  e $\frac{8}{25}$

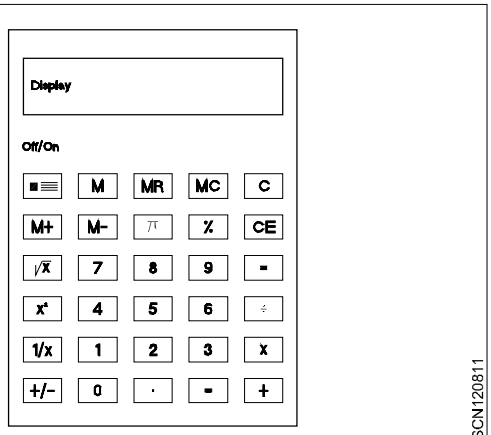
  f $1\frac{3}{25}$

A pocket calculator allows to spend less time in doing tideous calculations. A simple pocket calculator enables to do the arithmatical calculations of addition, substraction, multiplication and division, while a scientific type of calculator can be used for scientific and technical calculations also.

No special training is required to use a calculator. But it is suggested that a careful study of the operation manual of the type of the calculator is essential to become familiar with its capabalities. A calculator does not think and do. It is left to the operator to understand the problem, interpret the information and key it into the calculator correctly.

Constructional Details (Fig 1)

Fig 1



The key board is divided into five clear and easily recogniz able areas and the display

- **Data entry keys**

The entry keys are from [0] .....to [9]

and a key for the decimal point [.] .

- **Clearing keys**

These keys have the letter 'C'

[C] [CLR] Clear totally

[CE] Clear entry only

[CM] , [MC] Clear memory

[+] Addition key

[-] Subtraction key

[x] Multiplication key

[÷] Division key

[=] Equals key to display the result

- **Function keys**

[π] Pi key

[$\sqrt{x}$] Square root key

[%] Percentage key

[+/-] Sign change key

[x^2] Square key

[$\frac{1}{X}$] Reciprocal key

- **Memory keys**

[M] Store the display number

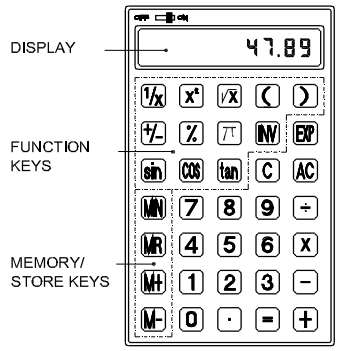
[M+] The displayed value is added to the memory

[M-] The displayed value is subtracted from the memory

[MR][RCL] The stored value is recalled on to the display

Further functional keys included in Scientific calculators are as shown in Fig 2.

Fig 2



Sin Cos Tan ( ) For trigonometric functions and for brackets

Exp Exponent key

INV Some of the keys have coloured lettering above or below them. To use a function in coloured lettering, press INV key. INV will appear on the display. Then press the key that the coloured lettering identifies. INV will disappear from the display.

log , INV 10^x to obtain the logarithm of the displayed number and the antilogarithm of the displayed value.

INV R–P to convert displayed rectangular coordinates into polar coordinates.

INV P–R to convert displayed polar coordinates into rectangular coordinates.

- **The display**

The display shows the input data, interim results and answers to the calculations.

The arrangement of the areas can differ from one make to another. Keying in of the numbers is done via. an internationally agreed upon set of ten keys in the order that the numbers are written.

Rules and Examples:

- **Addition:** Example 18.2 + 5.7

Sequence	Input	Display
Input of the 1st term of the sum	1 8 . 2	18.2
Press + key	+	18.2
Input 2nd term of the sum. the first term goes into the register	5 . 7	5.7
Press the = key	=	23.9

- **Subtraction:** Example 128.8 - 92.9

Sequence	Input	Display
Enter the subtrahend	1 2 8 . 8	128.8
Press - key	-	128.8
Enter the minnend. The subtrahend goes into the register	9 2 . 9	92.9
Press the = key	=	35.9

- **Multiplication:** Example 0.47 x 2.47

Sequence	Input	Display
Enter multiplicand	. 4 7	0.47
Press x key	x	0.47
Enter multiplier, multiplicand goes to register	2 . 4 7	2.47
Press = key	=	1.1609

- **Division:** Example 18.5/2.5

Sequence	Input	Display
Enter the dividend	1 8 . 5	18.5
Press ÷ Key	÷	18.5
Enter the divisor goes to the register	2 . 5	2.5
Press = key	=	7.4

- **Multiplication & Division:**
  Example : 2.5 x 7.2 / 4.8 x 1.25

Sequence	Input	Display
Enter 2.5	2 . 5	2.5
Press x key	x	2.5
Enter 7.2	7 . 2	7.2
Press ÷ key	÷	18
Enter 4.8	4 . 8	4.8
Press x key	x	3.75
Remember: Before input of the first value under the fraction line, the x key must be operated	1 . 2 5	1.25
	=	3.0
Enter 1.25		
Press = key		

- Store in memory Example (2+6) (4+3)

Sequence	Input	Display
Workout for the first bracket	2	2
	+	2
	6	6
	=	8
Store the first result in	STO , M	8
x	or M+	
Workout for the 2nd bracket	4	4
	+	4
	3	3
	=	7
Press x key	x	7
Recall memory	RCL or MR	8
Press = key	=	56

- **Percentage:** Example 12% of 1500

Sequence	Input	Display
Enter 1500	1 5 0 0	1500
Press x key	x	1500
Enter 12	1 2	12
Press INV %	INV %	12
Press = key	=	180

- **Square root:** Example $\sqrt{2+\sqrt{3\times5}}$

Sequence	Input	Display
Enter 2	2	2
Press $\sqrt{a}$ key	$\sqrt{a}$	2
Press + key	+	.
Press bracket key	(	.
Enter 3	3	3
Press $\sqrt{a}$ key	$\sqrt{a}$	.
Press x key	x	.
Enter 5	5	5
Press $\sqrt{a}$ key	$\sqrt{a}$	.
Press bracket close key	)	.
Press = key	=	5.2871969
2 √ + (3 √ x 5 √) =		5.2871969

$\sqrt{2+\sqrt{3\times5}} = 5$

- **Common logaritham:** Example log 1.23

Sequence	Input	Display
1 . 2 3 log	=	0.0899051

- **Power:** Example $123 + 30^2$

Sequence	Input	Display
1 2 3 + 3 0 INV X^2	=	1023

- **Before starting the calculations be sure to press the 'ON' key and confirm that '0' is shown on the display.**
- **Do not touch the inside portion of the calculator. Avoid hard knocks and unduly hard pressing of the keys.**
- **Maintain and use the calculator in between the two extreme temperatures of 0° and 40° C.**

- **Never use volatile fluids such as lacquer, thinner, benzine while cleaning the unit.**
- **Take special care not to damage the unit by bending or dropping.**
- **Do not carry the calculator in your hip pocket.**

Assignment

771 Using calculator solve the following

a 625 + 3467 + 20 + 341 + 6278 = _____

b 367.4 + 805 + 0.7 + 7.86 + 13.49 = _____

c 0.043 + 1.065 + 13.0 + 34.76 + 42.1 = _____

d 47160 + 1368.4 + 0.1 + 1.6901 + 134.267 = _____

2 Using calculator simplify the following

a 24367 - 4385 = _____

b 9.643 - 0.7983 = _____

c 4382.01 - 381.3401 = _____

d 693.42 - 0.0254 = _____

3 Using calculator find the values of the following

a 23 x 87 = _____

b 1376 x 0.81 = _____

c 678 x 243 = _____

d 0.75 x 0.24 = _____

4 Using calculator solve the following

a 22434 ÷ 3 = _____

b 4131 ÷ 243 = _____

c 469890 ÷ 230 = _____

d 3.026 ÷ 0.89 = _____

5 Solve the following

a $\frac{1170x537.5}{13x215}$ = _____

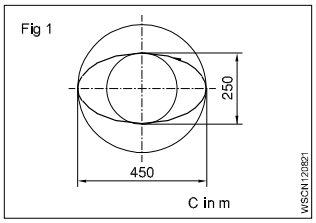
b $\frac{28.2x18x3500}{1000x3x0.8}$ = _____

6 Solve the following

a $\frac{(634+128)x(384-0.52)}{8x0.3}$ = _____

b $\frac{(389-12.2)x(842-0.05-2.6)}{(3.89-0.021)x(28.1+17.04)}$ = _____

7



2a = 450 mm(major axis)

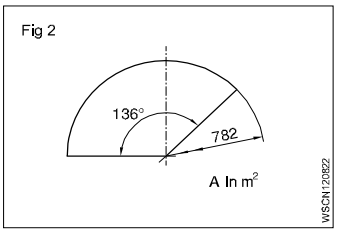
2b = 250mm(minor axis)

Perimeter of the ellipse

c = _____metre

Hint C = $\pi\sqrt{2(a^2+b^2)}$

8



ø = 782 mm

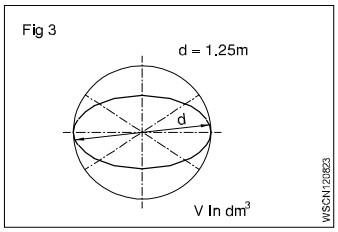
α = 136°

Area of the sector

A = _____

Hint A = $\frac{\pi x d^2}{4} x \frac{\alpha}{360°}$

9

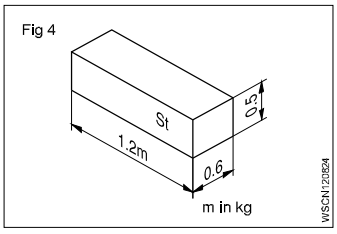


d = 1.25 metre

V = _____ dm^3

Hint V = $\frac{4}{3}\pi r^3$

10



L = 1.2 metres

B = 0.6 metre

H = 0.5 metre

'r' of steel

= 7.85 kg/dm^3'

m = _____ kg

(mass 'm = V x r)

1 Convert the following into improper fractions.

a $1\frac{2}{7} =$ _____

b $4\frac{3}{5} =$ _____

c $3\frac{3}{5} =$ _____

d $5\frac{7}{8} =$ _____

e $3\frac{1}{3} =$ _____

f $5\frac{3}{4} =$ _____

g $7\frac{3}{7} =$ _____

h $182\frac{1}{74} =$ _____

2 Convert the following into mixed numbers.

a $\frac{12}{11} =$ _____

b $\frac{36}{14} =$ _____

c $\frac{18}{10} =$ _____

d $\frac{25}{3} =$ _____

e $\frac{84}{13} =$ _____

f $\frac{32}{21} =$ _____

g $\frac{18}{16} =$ _____

h $\frac{75}{4} =$ _____

3 Place the missing numbers.

a $\frac{11}{13} = \frac{x}{91}$ _____

b $\frac{3}{5} = \frac{42}{x}$ _____

c $\frac{9}{14} = \frac{x}{98}$ _____

4 Simplify.

a $\frac{45}{60} =$ _____

b $\frac{8}{12} =$ _____

c $\frac{12}{14} =$ _____

d $\frac{56}{72} =$ _____

e $\frac{6}{14} =$ _____

f $\frac{3}{4} \times \frac{5}{7} \times \frac{11}{3} \times \frac{2}{4} \times \frac{14}{6} =$ _____

5 Multiply.

a $5 \times \frac{2}{3} =$ _____

b $\frac{3}{4} \times 2 =$ _____

c $\frac{3}{4} \times \frac{5}{6} =$ _____

d $3\frac{1}{4} \times 3 =$ _____

e $2\frac{1}{4} \times 3\frac{1}{4} =$ _____

f $5 \times 6\frac{1}{4} =$ _____

6 Divide

a $\frac{1}{4} \div \frac{3}{4} =$ _____

b $6 \div \frac{3}{4} =$ _____

c $\frac{3}{4} \div \frac{2}{7} =$ _____

d $3\frac{1}{6} \div 4 =$ _____

e $5\frac{1}{2} \div 2\frac{1}{7} =$ _____

f $8 \div 3\frac{1}{4}$ _____

7 Place the missing numbers.

a $\frac{2}{3} = \frac{1}{12}$ x _____

b $\frac{14}{24} = \frac{1}{12}$ x _____

c $\frac{7}{8} = \frac{1}{12}$ x _____

d $\frac{2}{36} = \frac{1}{12}$ x _____

e $\frac{52}{36} = \frac{1}{12}$ x _____

f $3\frac{11}{24} = \frac{1}{12}$ x _____

g $\frac{3}{4} = \frac{1}{12}$ x _____

h $\frac{7}{6} = \frac{1}{12}$ x _____

8 Add the followings:

a $\frac{3}{4} + \frac{7}{12} =$ _____

b $\frac{7}{8} + \frac{3}{4} =$ _____

c $\frac{3}{5} + \frac{4}{5} + \frac{3}{8} =$ _____

d $6\frac{1}{4} + 1\frac{7}{12} + 3\frac{7}{9} =$ _____

9 Subtract

a $\frac{4}{5} - \frac{2}{5} =$ _____

b $\frac{5}{6} - \frac{3}{4} =$ _____

10 Simplify

a $2\frac{6}{7} - \frac{3}{8} - \frac{1}{3} - 1\frac{1}{16} =$ _____

b $2\frac{2}{7} - \frac{5}{6} + 8 =$ _____

c $3\frac{7}{9} - \frac{3}{5} + 1\frac{3}{4} - 2 + \frac{1}{2} =$ _____

11 Express as improper fractions

a $5\frac{3}{4}$

b $3\frac{5}{64}$

c $1\frac{5}{12}$

12 Reduce to mixed number or whole number

a $\frac{163}{4}$

b $\frac{12}{4}$

c $\frac{144}{60}$

13 Reduce to lowest terms

a $\frac{12}{64}$

b $\frac{12}{48}$

c $\frac{144}{60}$

14 Addition of decimals

a 4.56 + 32.075 + 256.6245 + 15.0358

b 462.492 + 725.526 + 309.345 + 626.602

15 Subtract the following decimals

a 612.5200 – 9.6479

b 573.9246 – 215.6000

c 968.325 – 16.482

d 5735.4273 – 364.2342

16 Add and subtract the following

a 56.725 + 48.258 – 32.564

b 16.45 + 124.56 + 62.7 - 3.243

17 Multiplication of decimals

a By 10,100,1000

i 3.754

ii 8.964 x 100

iii 2.3786 x 1000

iv 0.005 x 1000

b By whole numbers

i 8.4 x 7

ii 56.72 x 8

c By another decimal figure (use calculator)

i 15.64 x 7.68

ii 2.642 x 1.562

18 Divide the following

a $\frac{62.5}{25}$

b $\frac{14.4}{9}$

c $\frac{64.56}{10}$

d $\frac{0.42}{100}$

e $\frac{48.356}{1000}$

f $\frac{25.5}{15}$

19 Division

a $\frac{16.8}{1.2}$

b $\frac{1.68}{1.2}$

c $\frac{0.168}{1.2}$

d $\frac{1.54}{1.1}$

e $\frac{27.2}{1.6}$

f 31.5 ÷ 10.5

g 1.54 ÷ 1.1

h 4.41 ÷ 2.1

20 Change the fraction into a decimal

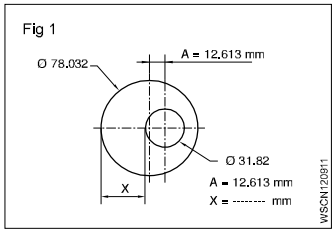
i $1\frac{5}{8}$

ii $\frac{12}{25}$

21 Find the value

20.5 x 40 ÷ 10.25 + 18.50

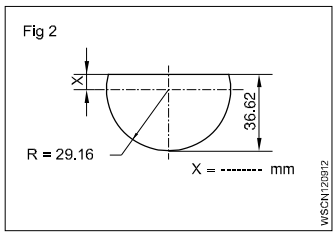
22



A = 12.613 mm

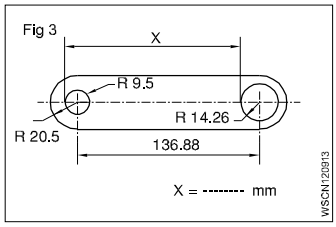
X = _____mm.

23



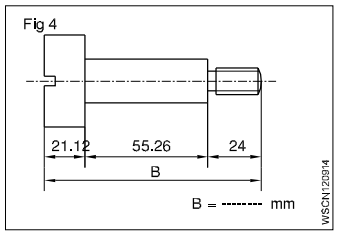
X = _____mm.

24



X = _____mm.

25



B = _____mm.