



Biomedical Instrumentation and Measurement

□ Units and physical constants

❖ Metric prefixes(公制字首)

TABLE 3-1 METRIC PREFIXES

Metric prefix	Multiplying factor	Symbol
tera	10^{12}	T
giga	10^9	G
mega	10^6	M
kilo	10^3	k
hecto	10^2	h
deka	10^1	da
deci	10^{-1}	d
centi	10^{-2}	c
milli	10^{-3}	m
micro	10^{-6}	μ
nano	10^{-9}	n
pico	10^{-12}	p
femto	10^{-15}	f
atto	10^{-18}	a

Biomedical Instrumentation and Measurement

❖ Standard physical units

TABLE 3-2 STANDARD PHYSICAL UNITS

Quantity	Unit	Symbol
Capacitance	farad	F
Electric charge	coulomb	C
Conductance	siemens	S
Conductivity	siemens/meter	S/m
Current	ampere	A
Energy	joule (watt-second)	J
Field	volts/meter	E
Flux linkage	weber(volt-second)	
Frequency	hertz	Hz
Inductance	henry	H
Length	meter	m
Mass	gram	g
Power	watt	W
Resistance	ohm	Ω
Time	second	s
Velocity	meter/second	m/s
Electric potential	volt	V



Biomedical Instrumentation and Measurement

❖ Physical constants

TABLE 3-3 PHYSICAL CONSTANTS

Constant	Value	Symbol
Boltzmann's constant	1.38×10^{-23} J/K	K
Electric charge (e^-)	1.6×10^{-19} C	q
Electron (volt)	1.6×10^{-19} J	eV
Electron (mass)	9.12×10^{-31} kg	m
Permeability of free space	$4\pi \times 10^{-7}$ H/m	U_o
Permittivity of free space	8.85×10^{-12} F/m	ϵ_o
Planck's constant	6.626×10^{-34} J-s	h
Velocity of electromagnetic waves	3×10^8 m/s	c
Pi	3.141592654	π



Biomedical Instrumentation and Measurement

❖ Conversion factors

TABLE 3-4 CONVERSION FACTORS

1 in.	=	2.54 cm
1 in.	=	25.4 mm
1 ft	=	0.305 m
1 mile	=	1.61 km
1 nautical mile	=	6,080 ft
1 statute mile	=	5,280 ft
1 mil	=	2.54×10^{-5} m
1 kg	=	2.2 lb
1 kg	=	1,000 g
1 g	=	1,000 mg
1 neper	=	8.686 dB
1 gaus	=	10,000 teslas
1 torr	=	1 mm Hg



Biomedical Instrumentation and Measurement

□ What is average ?

Example : Data values=[4,6,5,5,3,6,4,3,3,4,5,3,1,6,5,
2,5,2,3,4,4,5,7,7,8,4,6,5]

Find average of these data values.

Ans:

$$\bar{X} = \frac{X_1 + X_2 + X_3 \dots + X_n}{n}$$

$$\bar{X} = \frac{125}{28} = 4.46$$

☛ Arithmetic mean (算數平均數)