UNIT 1 UNITS ASSOSIATED WITH BASIC ELECTRICAL QUANTITIES

1.1 SI Unit

The system of units used in engineering and science is International system of units, usually abbreviated to SI units, and is based on the metric system.

Table 1.1 Basic SI Unit

Quantity	Unit	Unit Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	Ampere	A
Temperature	Kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

SI units may be made larger or smaller by using prefixes which denote multiplication or division by a particular amount. A prefix may be added to a unit to produce a multiple of the original unit. All multiple are integer power of ten. A prefix usually used show in Table 1.2.

Table 1.2 Standard prefixes for SI Units

Name	Prefix	Power of ten	Decimal equivalent
none	none	10^0	1
deca	da(D)	10^1	10
hector	h	10^2	100
Kilo	K	10^3	1 000
Mega	M	10^6	1 000 000
Giga	G	10^9	1 000 000
Tera	T	10^{12}	1 000 000 000 000
deci	d	10^{-1}	0.1
centi	c	10^{-2}	0.01
mili	m	10^{-3}	0.001
micro	µ	10^{-6}	0.000 001
nano	n	10^{-9}	0.000 000 001
pico	p	10^{-12}	0.000 000 000 001

Example 1

Perform the following conversion:

a. 56µ to milliseconds
b. 4.5m to millimeter
c. 150g to kilogram
d. 3.3kΩ to Ω

Solution 1:

a. 1ms = 1000μs
So $56\mu = \frac{56\mu \times 1\text{m}}{1000\mu} = 0.056\text{ms}$

b. 1m = 1000mm
So $4.5\text{m} = \frac{4.5\text{m} \times 1000}{1\text{m}} = 4500\text{mm}$

c. 1kg = 1000g
So $150\text{g} = \frac{150\text{g} \times 1\text{kg}}{1000\text{g}} = 0.15\text{kg}$

d. 1kΩ = 1000Ω
So $3.3\text{k}\Omega = \frac{3.3\text{k} \times 1000}{1\text{k}} = 3300\Omega$

1.2 Definition, units and symbols of electrical quantities

No.	Quantity, Symbol	Definition	Unit, Symbol
1	Charge, Q	Charge is defined as the quantity of electricity which flows past a given point in an electric circuit when a current of one ampere is maintained for one second. Q = It	Coulomb, C
2.	Work, W	The work is done when a force acts through a distance in a direction of the force.	Joule, J
3.	Power, P	Power is defined as the rate of doing work or transferring energy. $\text{P} = \frac{\text{W}}{\text{t}} = \frac{\text{E}}{\text{t}}$ Electric power is the rate of energy consumption in an electrical circuit. $\text{P} = \text{IV} = \text{I}^2\text{R} = \frac{\text{V}^2}{\text{R}}$	Watt, W
4.	Electromotive Force, e.m.f	The force or electrical pressure that causes a current to flow in a circuit equivalent to the potential difference between the terminals.	Volt, V
5.	Resistance, R	Resistance is defined as the resisting or opposing the current flow in conductor when a constant electric potential applied at the two points to produce a current. $\text{R} = \frac{\text{V}}{\text{R}}$	Ohm, Ω
6.	Current, I	Electrical current is a measure of the amount of electrical charge transferred per unit time.	Ampere, A
7.	Conductance, G	Conductance is the reciprocal of electrical resistance. $\text{G} = \frac{1}{\text{R}}$	Siemens, S
8.	Energy, E	Energy is ability to do work. E = Pt	Joule, J

Example 2

If a current of 10A flows for four minutes, find the quantity of electricity transferred.

Solution 2:

Quantity of electricity, Q=It coulombs. I =10A and t = 4 × 60 = 240s.
Hence
Q = 10 × 240 = 2400C

Example 3

Find the conductance of a conductor of resistance:

a. 25Ω b. 20 kΩ c. 10mΩ

Solution 3:

a. $\mathrm{G} = \frac{1}{\mathrm{R}} = \frac{1}{25} = 0.04\mathrm{S}$

b. $\mathrm{G} = \frac{1}{\mathrm{R}} = \frac{1}{20\times10^{3}} = 5 \times 10^{-5} = 50\mu\mathrm{S}$

c. $\mathrm{G} = \frac{1}{\mathrm{R}} = \frac{1}{10\times10^{-3}} = 100\mathrm{S}$

Example 4

A source e.m.f. of 15V supplies a current of 3A for 6 minutes. How much energy is provided in this time?

Solution 4:

E = Pt where P = IV = (3)(15) = 45W t = 6 X 60s = 360s

Hence, E = Pt = (45)(360)=16.2kJ

TUTORIAL 1

1. Rewrite the following as indicated:
   a. 1500 pF = _____ nF
   b. 0.06 µF = _____ pF
   c. 10000 kHz = _____ MHz
   d. 68 kΩ = _____ MΩ
   e. 0.56 mA =_____µA

2. Find the conductance of a resistor of resistance:
   a. 100Ω
   b. 50 kΩ
   c. 250mΩ

3. A conductor has a conductance of 25μS. What is its resistance?

4. An e.m.f. of 220V is connected across a resistance and the current flowing through the resistance is 5A. What is the power developed?

5. Find the electric power of an electrical circuit that consumes 120 joules for 20 seconds.

6. In what time would a current of 15A transfer a charge of 25 C?

7. A current of 10A flows for 15 minutes. What charge is transferred?

8. How long must a current of 100mA flow so as to transfer a charge of 80 C?

9. A 1.5KΩ resistor, and there is 25 volts across the resistor. Determine the power (in watts) that the resistor dissipates.

10. A battery of e.m.f. 10V supplies a current of 5A for 2 minutes. How much energy is supplied in this time?