

Section 10.1.1 – Basic Terminology

Voltage

Voltage is the "amount of energy each Coulomb of charge has".
It is also called the *electric potential difference*.

Voltage is measured in **Volts**.

NB: 1 Volt = 1 Joule / Coulomb

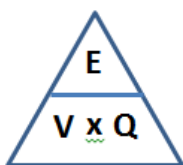


Alessandro Volta

Born: 18 Feb 1745 in Como, Italy

Died: 5 March 1827 in Como, Italy

$$V = \frac{E}{Q}$$



Where V is voltage (Volts)

E is energy (Joules)

Q is charge (Coulombs)

Example 1

What is the voltage of a Coulomb that has 12 Joules of energy?

$$V = ?$$

$$E = 12 \text{ J}$$

$$Q = 1 \text{ C}$$

$$V = \frac{E}{Q} = \frac{12}{1} = \underline{\underline{12 \text{ Volts}}}$$

Example 2

How much energy would 5 Coulomb's of charge, each at a potential difference of 4 Volts have?

$$E = ?$$

$$Q = 5 \text{ C}$$

$$V = 4 \text{ V}$$

$$E = QV = 5 \times 4 = 20 \text{ Joules}$$

Task 1 Complete the following tables in your notebook

E	Q	V
50 J	10 C	5 V
20 J	2 C	10V
120 J	4 C	30 V
200 J	40 C	5 V
180 J	30 C	6 V
2400 J	200 C	12 V

Task 2 Convert the following units of measurement back into volts:

- 5 millivolts (mV)
- 4 megavolts (MV)
- 10 microvolts (μV)
- 5.5 kilovolts (kV)
- 9.4 gigavolts (GV)

Description	Prefixes	Scientific Notation	Decimal
5 millivolts	5 mV	$5 \times 10^{-3} \text{ V}$	0.005 V
4 megavolts	4 MV	$4 \times 10^6 \text{ V}$	4000000 V
10 microvolts	10 μV	$10 \times 10^{-6} \text{ V}$	0.00001 V
5.5 kilovolts	5.5 kV	$5.5 \times 10^3 \text{ V}$	5500 V
9.4 gigavolts	9.4 GV	$9.4 \times 10^9 \text{ V}$	9400000000 V

Current

Current is the "amount of charge passing through a circuit every second".
It can be thought of as a **rate** at which charge passes.

Current is measured in **Amperes (A)**

NB: 1 Amp = 1 Coulomb / Second

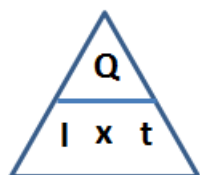


Andre-Marie Ampere

Born: 20 Jan 1775 in Lyon, France

Died: 10 June 1836 in Marseilles, France

$$I = \frac{Q}{t}$$



Where I is current (Amps)

Q is charge (Coulombs)

t is time (sec)

Example 1

What current is measured if 10 Coulomb's of charge pass along a circuit every 2 seconds?

$$I = ?$$

$$Q = 10 \text{ C}$$

$$t = 2 \text{ sec}$$

$$I = \frac{Q}{t} = \frac{10}{2} = \underline{\underline{5 \text{ Amps}}}$$

Example 2

How much charge passes through a circuit in 1 minute if 10 Amps of current is flowing?

$$Q = ?$$

$$t = 1 \text{ min}$$

$$= 60 \text{ sec}$$

$$I = 10 \text{ Amps}$$

$$Q = It = 10 \times 60 = 600 \text{ Coulombs}$$

Task 1 Complete the following table in your notebook

Q	I	t
10 A	2 A	5 sec
600 A	10 A	60 sec
400 C	50 A	8 sec
1200 C	10 A	2 min (120 Sec)
480 C	12 A	40 sec
960 C	4 A	240 sec

Task 2

Convert the following units of measurement back into amps:

- 3 kilo-amps (kA)
- 4 micro-amps (μA)
- 0.5 giga-amps (GA)
- 20.5 mega-amps (MA)
- 0.5 milli-amps (mA)

Description	Prefixes	Scientific Notation	Decimal
3 kilo amps	3 kA	$3 \times 10^3 \text{ A}$	3000 A
4 micro-amps	4 μA	$4 \times 10^{-6} \text{ A}$	0.000004 A
0.5 giga-amps	0.5 GA	$0.5 \times 10^9 \text{ A}$	500000000 A
20.5 mega-amps	20.5 MA	$20.5 \times 10^6 \text{ A}$	20500000 A
0.5 milli-amps	0.5 mA	$0.5 \times 10^{-3} \text{ A}$	0.0005 A

Metric prefixes							
Prefix	Symbol	1000^m	10^n	Decimal	Short scale	Since [n 1]	
yotta	Y	1000^8	10^{24}	1 000 000 000 000 000 000 000 000 000	septillion	1991	
zetta	Z	1000^7	10^{21}	1 000 000 000 000 000 000 000 000	sextillion	1991	
exa	E	1000^6	10^{18}	1 000 000 000 000 000 000 000	quintillion	1975	
peta	P	1000^5	10^{15}	1 000 000 000 000 000 000	quadrillion	1975	
tera	T	1000^4	10^{12}	1 000 000 000 000 000	trillion	1960	
giga	G	1000^3	10^9	1 000 000 000	billion	1960	
mega	M	1000^2	10^6	1 000 000	million	1960	
kilo	k	1000^1	10^3	1 000	thousand	1795	
hecto	h	$1000^{2/3}$	10^2	100	hundred	1795	
deca	da	$1000^{1/3}$	10^1	10	ten	1795	
		1000^0	10^0	1	one	–	
deci	d	$1000^{-1/3}$	10^{-1}	0.1	tenth	1795	
centi	c	$1000^{-2/3}$	10^{-2}	0.01	hundredth	1795	
milli	m	1000^{-1}	10^{-3}	0.001	thousandth	1795	
micro	μ	1000^{-2}	10^{-6}	0.000 001	millionth	1960	
nano	n	1000^{-3}	10^{-9}	0.000 000 001	billionth	1960	
pico	p	1000^{-4}	10^{-12}	0.000 000 000 001	trillionth	1960	
femto	f	1000^{-5}	10^{-15}	0.000 000 000 000 001	quadrillionth	1964	
atto	a	1000^{-6}	10^{-18}	0.000 000 000 000 000 001	quintillionth	1964	
zepto	z	1000^{-7}	10^{-21}	0.000 000 000 000 000 000 001	sextillionth	1991	
yocto	y	1000^{-8}	10^{-24}	0.000 000 000 000 000 000 000 001	septillionth	1991	

1. ^ The metric system was introduced in 1795 with six prefixes. The other dates relate to recognition by a resolution of the CGPM.