Physical quantities

Learning outcomes:

Physical quantities
SI units
The Avogadro constant
Scalars and vectors

SI BASE UNITS

QUANTITY	SYMBOL	UNIT
mass	m	kilograms (kg)
length	L	meters (m)
time	t	seconds (s)
current	I	amps (A)
temperature	T	kelvin (K)
amount	n	moles (mol)

DERIVED UNITS

Velocity:

$V = ds/dt$

$= m/s$

Acceleration

$a = v\text{-}u/t$

$= m/s^2$

Energy:

$E = w = fs$

$= kgm^2s^{-2}$

Potential difference:

$V = W/Q = fs/It$

$= kgm^2s^{-3}A^{-1}$

Specific heat capacity:

$C = E/mT = mas/mT$

$= kg^{-1}m^2s^{-2}$

Forces, density and pressure

Learning outcomes:

Types of forces
Turning effects of forces
Equilibrium of forces
Density and pressure

FORCE

Rate of change of momentum.

DENSITY

Mass per unit volume of a substance.

PRESSURE

Force per unit area.

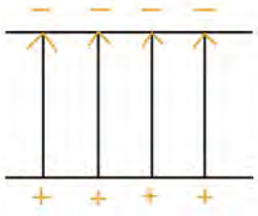
MOTION IN G-FIELD

- Force per unit mass.
- G = force/mass = ~~m~~a/~~m~~ = a =m/s^2
- A region of space in which a mass experiences an (attractive) force due to the presence of another mass

MOTION IN E-FIELD

- Force per unit positive charge.
- E = f/q
- A region of space where a charge experiences an (attractive or repulsive) force due to the presence of another charge

Eg. Draw the E field between 2 plates showing it to be uniform.



*messenger = positive charge :. attracted to -ve

*uniform e field shown by:

1. Equidistant lines
2. Parallel lines

E = potential gradient = voltage/distance

Waves

Learning outcomes:

Progressive waves
Transverse and longitudinal waves
Determination of frequency and wavelength of sound waves
Doppler effect
Electromagnetic spectrum
(Production and use of ultrasound diagnosis A2)

DISPLACEMENT

The vector distance from its undisturbed position at any instant.

AMPLITUDE

The maximum displacement.

PERIOD

The time taken for one complete oscillation.

FREQUENCY

The number of oscillations per unit time.

$F = 1/T$

WAVELENGTH

The distance from any point on the wave to the next same point.

WAVE SPEED

Speed at which the waveform travels in the direction of the propagation of the wave.

PROGRESSIVE WAVE

Transfers energy from one position to another.

Current of electricity

Learning outcomes:

Electric current
Potential difference and power
Resistance and resistivity
(Sensing devices A2)

ELECTRIC CURRENT

The rate of flow of charged particles

CHARGE

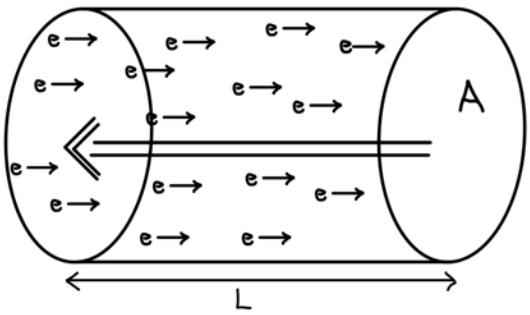
- Q = IT = C
- Charge = current x time

(Coulomb = charge flowing per second at a current of 1A)

Charge is quantised ie. not continuous but consists of “tiny packets” / is discreet

Therefore all charges are multiples of the charge of 1e = 1.6 x 10^{-19}C

RELATION BETWEEN CURRENT AND DRIFT VELOCITY



vol = AL
no. free electrons = nLA
total charge = Q = nLAq

t = L/V

Therefore

I = Q/T = (nŁAq) / (Ł/v) = nAqv

- n = number of free electrons
- q = charge on 1 electron
- v = average drift velocity

Conductors have trillions more free electrons :. velocity is slow (n proportional to 1/v)

Conclusion:

1. All mass concentrated in the center of atom :. nucleus is very small and very dense
2. Nucleus is positively charged as alpha particles are repelled / deflected

NUCLEON NUMBER

Total number of protons and neutrons (in nucleus)

PROTON/ ATOMIC NUMBER

Total number of protons

ISOTOPE

Atoms with the same proton number (same element) with a different nucleon number (different no. neutrons)

NUCLEAR PROCESSES

1. Nucleon number
2. Proton number = **conserved**
3. Mass-energy
4. (+charge and momentum)

RANDOM AND SPONTANEOUS RADIOACTIVITY

Random

- Impossible to predict
- Each nucleus has the same probability of decaying per second
- Graph will have fluctuations in count rate

Spontaneous

- Not affected by external factors (eg other nuclei, temp, pressure)
- Graph has same shape even at different temperatures, pressures etc.