



IB Physics — Topic 0

Units & Prefixes

Study notes · 完整复习笔记

1. Quantities and Units

A quantity is something that can be measured (time, length, electric current).

A unit is what you measure that quantity in (second, metre, ampere).

量(quantity)= 可以测量的东西;单位(unit)= 用什么标准去测量。

IB writing conventions 书写规范

- Quantities are written in italics: $v = \Delta s / \Delta t$
- Units are written in Roman upright type: s, hr, ft, m, A
- A unit written out in full is always lower case: metre, newton, pascal, ampere, second
- A unit symbol takes a capital FIRST letter if it is named after a person — only the first letter: N (newton), A (ampere), Pa (pascal), K (kelvin), Hz (hertz). Pa, never PA.

SI base quantities and units 基本量与基本单位

Quantity	Unit name	Symbol
length	metre	m
time	second	s
mass	kilogram	kg
electric current	ampere	A
thermodynamic temperature	kelvin	K
amount of substance	mole	mol
luminous intensity	candela	cd

七个基本量必须背熟。

Derived units 导出单位

Derived units are built from base units. IB writes them with negative indices and spaces, not with a slash:

m s^{-1} not m/s kg m^{-3} not kg/m^3

Worked examples

Volume of a cube of edge 2.0 m: $V = 2.0^3 = 8.0 \text{ m}^3$

Density of a 16.0 kg cube of edge 2.0 m: $\rho = \frac{m}{V} = \frac{16.0}{8.0} = 2.0 \text{ kg m}^{-3}$

Velocity of a car covering 10.0 m in 2.00 s: $v = \frac{\Delta s}{\Delta t} = \frac{10.0}{2.00} = 5.00 \text{ m s}^{-1}$

Acceleration $a = \frac{\Delta v}{\Delta t} \rightarrow \frac{\text{m s}^{-1}}{\text{s}} = \text{m s}^{-2}$

Force $F = ma \rightarrow \text{kg} \times \text{m s}^{-2} = \text{kg m s}^{-2}$, so $1 \text{ N} = 1 \text{ kg m s}^{-2}$

导出单位的方法:把公式里每个量换成基本单位,再化简。



2. Scientific Notation, Prefixes, Orders of Magnitude

Scientific notation 科学记数法

$$c = 3.00 \times 10^8 \text{ m s}^{-1}$$

- Coefficient (系数) = 3.00 — must satisfy $1 \leq \text{coefficient} < 10$
- Base (底数) = 10
- Exponent (指数) = 8

SI prefixes 词头

Prefix	Sym	Factor	Prefix	Sym	Factor
peta	P	10^{15}	deci	d	10^{-1}
tera	T	10^{12}	centi	c	10^{-2}
giga	G	10^9	milli	m	10^{-3}
mega	M	10^6	micro	μ	10^{-6}
kilo	k	10^3	nano	n	10^{-9}
hecto	h	10^2	pico	p	10^{-12}
deca	da	10^1	femto	f	10^{-15}

大写 M 是 mega(10^6), 小写 m 是 milli(10^{-3}), 差 10^9 倍——大小写千万别写错。

Converting with prefixes

$$300 \text{ mm} = 300 \times 10^{-3} \text{ m} = 3.00 \times 10^{-1} \text{ m}$$

$$368 \text{ } \mu\text{m} = 368 \times 10^{-6} \text{ m} = 3.68 \times 10^{-4} \text{ m}$$

$$200 \text{ MV} = 200 \times 10^6 \text{ V} = 2.00 \times 10^8 \text{ V}$$

$$0.000000056 \text{ m} = 0.056 \times 10^{-6} \text{ m} = 0.056 \text{ } \mu\text{m} \quad (= 56 \text{ nm})$$

$$10 \text{ m} \div 200 \text{ mm} = 10 / (200 \times 10^{-3}) = 10 / 0.200 = 50 \quad (\text{a ratio — no units})$$

先把词头换成 10 的幂, 再调整系数到 1–10 之间。

面积和体积 A prefix inside a squared or cubed unit is raised to that power too: $1 \text{ cm}^2 = (10^{-2} \text{ m})^2 = 10^{-4} \text{ m}^2$, and $1 \text{ cm}^3 = 10^{-6} \text{ m}^3$. 面积换算进率要平方, 体积要立方。

Order of magnitude 数量级

The power of ten nearest to the number.

Write it in scientific notation and read off the exponent.

Example

A sheet of paper of mass $3.8 \text{ g} = 3.8 \times 10^{-3} \text{ kg} \rightarrow$ order of magnitude 10^{-3} kg .