# An ‘alphabet of physics’

Within the language of physics, students must become familiar with common units and prefixes defined in the International System of Units (SI). Each SI prefix has a defined single letter abbreviation; each SI unit has an abbreviation, most are one or two letters. Beyond prefixes and units, in calculations, it is often convenient to represent physical quantities with an algebraic symbol. Students will encounter other symbols and abbreviations (for example in diagrams).

In GCSE (9-1) Physics, some letters are commonly used only for one purpose, for example J is only used as the abbreviation of joule. However, some letters can represent more than one thing: a prefix, a unit, and one or more quantities. For example, M is a prefix meaning mega, and *M* is also a symbol that is commonly used for the quantity moment. When written in lower case, m can mean the prefix milli or the unit metre, and *m* is a common symbol for the quantity mass.

Tables of prefixes, units and quantities are included in the specifications. The list below is rather different. It shows all standard abbreviations and all symbols arranged in alphabetical order. In this table, each of the right hand columns is independent of the others, for example, A may represent ‘area’ or ‘ampere’. We hope that this ‘alphabet of physics’ will help students to avoid confusion by highlighting where it might most easily occur.

* SI prefix - this shows the standard prefixes and their single letter abbreviations
* Standard unit - this shows the standard units and their standard abbreviations
* Quantity (with symbols as used in our symbol equations) - this shows all the quantities required by the specification, arranged in alphabetical order of the symbol that we have adopted for our symbolic equations. In some cases one abbreviation might represent two different quantities, for example momentum and pressure both have the same quantity symbol, *p*. Each quantity appears on a new line in the appropriate cell of the table.
* Other symbols / other uses - here we include other uses that could cause confusion
	+ while the specification does not demand any calculation using the quantity amplitude, we recognise that students might encounter a diagram of a wave that includes *A* as a label for amplitude
	+ While we use *c* as the symbol for specific heat capacity, students might also see *c* used to represent the speed of electromagnetic waves in a vacuum. As the specification does not require the latter, this use appears in this column.
	+ We highlight the possible confusion between the Greek letter rho (*r*) and the letter *p*.
	+ We highlight the Greek letters alpha, beta and gamma - none of these are used in our symbolic equations, but these might be used in nuclear decay equations.

| **Letter** | **SI prefix** | **Standard Unit** | **Quantity (with symbols as used in our symbol equations)** | **Other symbols / other uses** |
| --- | --- | --- | --- | --- |
| A, a |  |  | A | ampere (amp) | *A* | area | wave amplitude, *A;*in chemistry, state symbol (aq) |
|  |  |  |  | *a* | acceleration |
| B, b |  |  |  |  | *B* | magnetic flux density |  |
| C, c |  |  | C°C | coulombdegree Celsius |  |  | speed of light (and all electromagnetic waves) in a vacuum, *c*intercept of a straight line, *c* |
| c | centi |  |  | *c* | specific heat capacity |
| D, d |  |  |  |  | *d* | distance measured at right angles between the line of action of a force and the pivot |  |
| E, e |  |  |  |  | *E* | energy (transferred) | electron, e |
| F, f |  |  |  |  | *F* | force |  |
|  |  |  |  | *f* | frequency |
| G, g | G | giga |  |  |  |  | in chemistry, state symbol, (g) |
|  |  | g | gram | *g* | gravitational field strength |
| H, h |  |  | Hz | hertz | *h* | height | hour, *h* |
| I, i |  |  |  |  | *I* | electric current | angle of incidence, *i* |
| J, j |  |  | J | joule |  |  |  |
| K, k |  |  | K | kelvin |  |  |  |
| k | kilo | kg | kilogram | *k* | spring constant |
| L, l |  |  | l | litre | *l* | length;specific latent heat | in chemistry, state symbol, (l) |
| M, m | M | mega |  |  | *M* | moment | Molgradient of a straight line, *m*minute may be abbreviated to min |
| m | milli | m | metre | *m* | Mass |
| N, n |  |  | N | newton | *N* | number of turns | in chemistry, Avogadro constant, *N*A |
| n | nano |  |  | *n* | amount (number of moles) |
| P, p |  |  | Pa | pascal | *P* | power | for pressure *P* is sometimes usedtake care to avoid confusion between *p* and *r,* the symbol for density |
| p | pico |  |  | *p* | pressure; momentum |
| Q, q |  |  |  |  | *Q* | electric charge |  |
| R, r |  |  |  |  | *R* | electric resistance | angle of reflection (or refraction), *r* |
| S, s |  |  | s | second | *s* | displacement (or distance) | in chemistry, state symbol, (s) |
| T, t | T | tera | T | tesla | *T* | temperature (kelvin);periodic time |  |
|  |  |  |  | *t* | time |
| U, u |  |  |  |  | *u* | initial velocity (or initial speed) |  |
| V, v |  |  | V | volt | *V* | volume;electric potential difference |  |
|  |  |  |  | *v* | velocity (or speed) in general;final velocity (or final speed) |
| W, w |  |  | W | watt | *W* | weight;work done (mechanically or electrically) |  |
| X, x |  |  |  |  | *x* | extension | *x*-axis; X-rays |
| Y, y |  |  |  |  |  |  | *y*-axis |
| a (alpha) |  |  |  |  |  |  | alpha radiation, a |
| b (beta) |  |  |  |  |  |  | beta radiation, b |
| g (gamma) |  |  |  |  |  |  | gamma radiation, g |
| D (delta) |  |  |  |  |  |  | change in, D |
| *q* (theta) |  |  |  |  | *q* | temperature (Celsius) | commonly used for angles |
| *l* (lambda) |  |  |  |  | *l* | wavelength |  |
| m (mu) | m | micro |  |  |  |  |  |
| *r* (rho) |  |  |  |  | *r* | density | take care to avoid confusion between *r* and *p,* the symbol for pressure or momentum |
| W (omega) |  |  | W | ohm |  |  |  |

## Questions to check understanding

1. Which unit has the abbreviation J?
2. Some units are named after people. The abbreviations of these units are either a single upper case (capital letter) or an upper case letter followed by a lower case letter.
	1. Find one unit that is named after a person and abbreviated to a single letter.
	2. Find one unit that is named after a person and abbreviated to two letters.
3. Find one unit abbreviation that is a single letter that’s not in the English alphabet.
4. Some units have a lower case (small) letter as their abbreviation. Find three **units** that are lower case letters. Write down the units and their abbreviations.
5. Sometimes a prefix is added to a unit. For example the word centimetre is made up of the unit ‘metre’ with the prefix ‘centi’ written immediately before it. When we write a unit abbreviation, we write the letters with no space between them, so centimetre is written cm.
	1. The prefix mega means million (1 000 000, or 106). What is the abbreviation for mega?
	2. The prefix milli means one thousandth ($\frac{1}{1000}$, or 10-3). What is the abbreviation for milli?
	3. Write down the abbreviations for each of these units:
		1. millisecond
		2. kilojoule
		3. megaohm
		4. micrometre
6. Write down the unit that is represented by each of these abbreviations:
	1. kHz
	2. mK
	3. MW
7. Sometimes units might look similar but be very different. Write down the units that match these abbreviations:
	1. mm, Mm
	2. pA, Pa
8. In equations, we sometimes write symbols to represent quantities (in place of words). A symbol is usually a single letter, and when they are printed, they are shown in *italic* (sloping) text.
	1. What quantity is represented by *A*?
	2. What quantity is represented by *a*?
9. Some symbols stand for more than one quantity.
	1. What two quantities both use the symbol *p*?
	2. What can be represented by *V* or *v*?
	3. What is the symbol for weight? What other quantity uses the same symbol?
10. Some letters are used as symbols, and as prefixes or quantities.
	1. Write down what is represented by
		1. g
		2. *g*
		3. G
	2. Write down what is represented by
		1. mg
		2. *m g*
	3. Write down what is represented by
		1. pV
		2. *p V*
	4. Write down what is represented by
		1. mV
		2. *m v*
	5. Write the following using symbols or abbreviations:
		1. newton metre
		2. nanometre

## Answers (and commentary)

After each question, the answer is shown in **bold**. Where space allows, answers are on the same line as the question. Otherwise, answers appear on a separate line below the question.

Commentary notes are provided after some of the answers.

1. Which unit has the abbreviation J?

**joule** – this is the only common use for J in GCSE Physics

1. Some units are named after people. The abbreviations of these units are either a single upper case (capital letter) or an upper case letter followed by a lower case letter.
	1. Find one unit that is named after a person and abbreviated to a single letter.

**A, C, K, N, W, V, W**, abbreviations of ampere (or amp), coulomb, kelvin, newton, watt, volt, ohm. (Units named after people start with a lower case letter when the full name of the unit is written, but each abbreviation begins with a capital letter; if we write about the people, we use a capital, e.g. “the newton is named after Newton.”)

* 1. Find one unit that is named after a person and abbreviated to two letters.

**Hz, Pa**

Hz (hertz), Pa (pascal).

1. Find one unit abbreviation that is a single letter that’s not in the English alphabet. **W** (abbreviation of ohm)
2. Some units have a lower case (small) letter as their abbreviation. Find three **units** that are lower case letters. Write down the units and their abbreviations.

**g, m, s** – gram, metre, second (the gram is a unit used in SI, but the SI standard unit of mass is the kilogram).

1. Sometimes a prefix is added to a unit. For example the word centimetre is made up of the unit ‘metre’ with the prefix ‘centi’ written immediately before it. When we write a unit abbreviation, we write the letters with no space between them, so centimetre is written cm.
	1. The prefix mega means million (1 000 000, or 106). What is the abbreviation for mega?

**M**

* 1. The prefix milli means one thousandth ($\frac{1}{1000}$, or 10-3). What is the abbreviation for milli?

**m**

* 1. Write down the abbreviations for each of these units:
		1. millisecond – **ms (not Ms, not m s)**
		2. kilojoule – **kJ (not KJ)**
		3. megaohm - **MW (not mW)**
		4. micrometre - **mm (not mM)**
1. Write down the unit that is represented by each of these abbreviations:
	1. kHz – **kilohertz**
	2. mK – **millikelvin**
	3. MW – **megawatt**
2. Sometimes units might look similar but be very different. Write down the units that match these abbreviations:
	1. mm, Mm – **mm = millimetre, Mm = megametre** (Megametre is technically correct, but for lengths/distances the only ‘large’ prefix that is commonly used is kilo.)
	2. pA, Pa – **pA = picoampere or picoamp, Pa = pascal**
3. In equations, we sometimes write symbols to represent quantities (in place of words). A symbol is usually a single letter, and when they are printed, they are shown in *italic* (sloping) text.
	1. What quantity is represented by *A*? **Area**
	2. What quantity is represented by *a*? **Acceleration**
4. Some symbols stand for more than one quantity.
	1. What two quantities both use the symbol *p*?

**pressure and momentum**

* 1. What can be represented by *V* or *v*?

***V* = volume and electric potential difference**

***v* = velocity (or speed)**, in questions where the speed/velocity increases, we use *u* for the initial value and *v* for final value.

* 1. What is the symbol for weight? What other quantity uses the same symbol?

***W* = weight**; *W* is also used for **work**

1. Some letters are used as symbols, and as prefixes or quantities.
	1. Write down what is represented by
		1. g – **gram** (the g here is upright so it must be a unit or a prefix; there is no prefix abbreviated to g)
		2. *g* – **gravitational field strength** (italic text indicates that this is a quantity symbol)
		3. G – **giga** (there is no SI unit that’s abbreviated to G)
	2. Write down what is represented by
		1. mg – **milligram**
		2. *m g* – **mass × gravitational field strength**
	3. Write down what is represented by
		1. pV – **picovolt**
		2. *p V* – **pressure × volume**
	4. Write down what is represented by
		1. mV – **millivolt**
		2. *m v* – **mass × velocity**
	5. Write the following using symbols or abbreviations:
		1. newton metre – **N** **m**
		2. nanometre – **nm**



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