A-LEVEL PHYSICS • EXERCISE SHEET

1.2 SI units

Name: _____ Class: _____ Date: _____ **Total: 12 marks**

Objective

Build the skills to answer exam questions on **SI units** 国际单位制—base units, derived units, homogeneity and prefixes.

You must be able to:

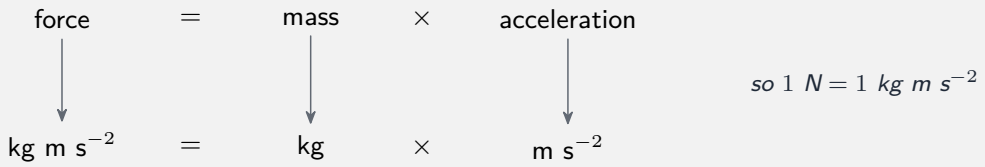
- recall the **five SI base units** (kg, m, s, A, K)
- express a **derived unit** in SI base units
- check the **homogeneity** of an equation and use **prefixes**

1 Worked examples

Study these first. Each one shows the method for a question type used later —follow the steps and you can do the Practice and Exam-style questions yourself.

■ Base and derived units

The **base quantities**: mass (kg), length (m), time (s), current (A), temperature (K). Build a **derived unit** from the equation that defines it:



So 1 N = 1 kg m s^{-2}; the **joule** = kg m^2 s^{-2}; the **watt** = kg m^2 s^{-3}; the **pascal** = kg m^{-1} s^{-2}.

■ Checking homogeneity

An equation is **homogeneous** when both sides have the **same base units**. Check $v^2 = u^2 + 2as$:

- LHS: $(\text{m s}^{-1})^2 = \text{m}^2\,\text{s}^{-2}$
- u^2: $\text{m}^2\,\text{s}^{-2}$; $2as$: $(\text{m s}^{-2})(\text{m}) = \text{m}^2\,\text{s}^{-2}$

Both sides are $\text{m}^2\,\text{s}^{-2}$ —homogeneous. (Matching units do **not** prove it fully correct, but **mismatched** units prove it wrong.)

■ **Prefixes**

p	n	μ	m	c	d	k	M	G	T
10^{-12}	10^{-9}	10^{-6}	10^{-3}	10^{-2}	10^{-1}	10^{3}	10^{6}	10^{9}	10^{12}

2 Practice

Now apply the methods above.

2.1 Name the **five** SI base quantities and give each unit. [2]

2.2 Write the SI **base units** of **force**. [1]

2.3 Write 5 mA in **amperes**, in standard form. [1]

2.4 Write 2.0 GHz in **hertz**, in standard form. [1]

3 Exam-style questions

3.1 The SI base units of the **watt** are: [1]

- **A** kg $m^2 s^{-2}$
- **B** kg $m^2 s^{-3}$
- **C** kg m s^{-2}
- **D** kg $m^{-1} s^{-2}$

3.2 Derive the SI base units of **pressure** (pressure = force / area). [2]

3.3 Use base units to check whether $E = \frac{1}{2}mv^2$ is **homogeneous**. [3]

3.4 Which prefix means 10^{-9}? [1]

- **A** micro
- **B** nano
- **C** pico
- **D** milli

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4 Go further

You are now ready for the real exam questions on this subtopic. Open the **1.2 SI units** past-paper sheet in the Library, or try these in **Practice mode**:

- 9702/12 J25 —Q2 (SI base units)
- 9702/11 N25 —Q3 (base units of a derived quantity)
- 9702/21 N25 —Q2 (units and homogeneity)
- 9702/13 J25 —Q1 (SI units)

Solutions

2.1 mass —kg; length —m; time —s; current —A; temperature —K.

2.2 kg m s^{-2}.

2.3 5 mA = 5×10^{-3} A.

2.4 2.0 GHz = 2.0×10^{9} Hz.

3.1 B —kg m^2 s^{-3}.

3.2 pressure = force / area = kg m s^{-2}/m^2 = kg m^{-1} s^{-2}.

3.3 LHS (energy) = kg m^2 s^{-2}; RHS $\frac{1}{2}mv^2$ = kg × (m s^{-1})^2 = kg m^2 s^{-2}; both sides equal, so it **is homogeneous** (the $\frac{1}{2}$ has no units).

3.4 B —nano.