Edexcel Physics A-level

Topic 1: Working as a Physicist

Key Points

SI Base Units

The **base units** are the set of seven units of measure from which all other SI units can be derived. The ones you need to know are:

- Mass: Kilogram (kg)
- Length: Metre (m)
- Time: Second (s)
- Current: Amps (A)
- Temperature: Kelvin (K)
- Amount of Substance: Mole (mol)

All other units can be expressed in terms of the base units. For example:

$1\ J = 1\ kgm^2s^{-2}$

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

Unit Prefixes

Unit prefixes should be used when stating very large or very small values, in order to avoid the use of large amounts of zeros or standard form. You need to know the following prefixes:

T, tera: 10^{12}
G, giga: 10^{9}
M, mega: 10^{6}
k, kilo: 10^{3}
c, centi: 10^{-2}
m, milli: 10^{-3}
μ, micro: 10^{-6}
n, nano: 10^{-9}
p, pico: 10^{-12}
f, femto: 10^{-15}

You can convert between prefixes and standard form. For example:

$620\ \text{nm} = 620 \times 10^{-9}\ \text{m} = 6.20 \times 10^{-7}\ \text{m}$

Significant Figures

Your **calculated quantities** should be given to the same number of significant figures as the value with the **least** number of significant figures used in the calculation.

In **tables**, data should be written to the same number of significant figures. However, when the data has a large range (e.g it crosses several multiples of 10), the same number of decimal places should be used to avoid changing the **accuracy**.

The number of decimal places of the **logarithm** of a value should be the same as the number of significant figures of the value. For example, ln(61) should be quoted as 4.11

Experimental Key Terms

Random error: Measurements vary due to unpredictable circumstances. They cannot be corrected and can only be mitigated by making more measurements and calculating a new mean.

Systematic error: Measurements differ from the true value by a consistent amount each time. They can be corrected by using a different technique to take measurements and calibrating measuring instruments.

Precision: How close measurements are to each other and the mean.

Accuracy: How close a measurement is to the true value.

Repeatable: When the original experimenter repeats the investigation using the same method and equipment and obtains the same results.

Reproducible: When somebody else repeats the investigation or the investigation is performed using different equipment or techniques and the same results are obtained.

Resolution: The smallest change in a quantity being measured that gives a perceptible change in the reading.

Physical measurements are limited by the resolutions of measuring instruments and errors in measurements.

Estimation of Physical Quantities

You can **estimate** the order of magnitude of physical quantities.
Examples include:

Radius of proton: 10^{-15} m
Radius of atom: 10^{-10} m
Height of human: 10^{0} m
Radius of earth: 10^{7} m

Estimation is a skill physicists must use in order to approximate the values of physical quantities, in order to make comparisons, or to check if a value they've calculated is reasonable.

Benefits and Risks of Science

Throughout the course, you should consider the **benefits** and **risks** that different scientific applications have on **society**. One of the major areas where this prevalent is when considering **nuclear physics**:

- Nuclear radiation such as gamma rays can be used to target and kill **cancerous cell**
- Radioactive tracers are regularly used in **medical treatments**
- Nuclear **energy** from **fission** is a very effective method of energy production, that doesn't contribute to **global warming** but that does pose a **risk** of a **nuclear disaster**

Validating new knowledge

Knowledge and understanding of any scientific concept changes over time in accordance to the **experimental evidence** gathered by the scientific community. However, these pieces of experimental evidence must first be **published** to allow them to be **peer-reviewed** by the community to become validated, and eventually accepted.

Once new knowledge has been accepted by the scientific community, it can be used to **inform** the decisions made by society. For example, investigations into the effectiveness and safety of a certain drug will allow doctors to decide whether the benefits outweigh the risks and whether they should administer that drug to their patients.