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| 1 | Science Skills | IB Physics Content Guide |

# Big Ideas

* Units are an arbitrary construct invented by humans to communicate quantitative measurements
* All units can be made up of the 7 Fundamental SI Units
* Metric prefixes and scientific notation can be used to make large or small values easier to communicate
* Units can cancel out when being divided by like units
* Unit analysis can be used to determine the validity of a formula or determine the unit of an unknown solution
* No measurement or calculation from measurement is exact. There is a certain range of uncertainty

# Content Objectives

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| 1.2 – Units |  | | | |
| I can describe the difference between quantitative and qualitative observations | |  |  |  |
| I can identify the 7 Fundamental SI units | |  |  |  |
| I can define and give an example of a derived unit | |  |  |  |
| I can represent fractional units with negative exponents | |  |  |  |
| I can convert metric units between prefixes | |  |  |  |

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| 1.3 – Dimensional Analysis |  | | |
| I can convert fraction units and exponential units using Dimensional Analysis |  |  |  |
| I can use dimensional analysis to verify a formula |  |  |  |
| I can use dimensional analysis to determine the units for a solution |  |  |  |
| I can represent large and small numbers using scientific notation |  |  |  |
| I can compare quantities by orders of magnitude |  |  |  |

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| 1.4 – Uncertainty |  | | |
| I can define and compare the terms precision and accuracy |  |  |  |
| I can define and compare random and systematic error |  |  |  |
| I can report a measurement to the appropriate level of precision (decimal places) |  |  |  |
| I can report a measurement with the proper uncertainty for the instrumentation used |  |  |  |
| I can determine the number of significant digits in a reported value |  |  |  |

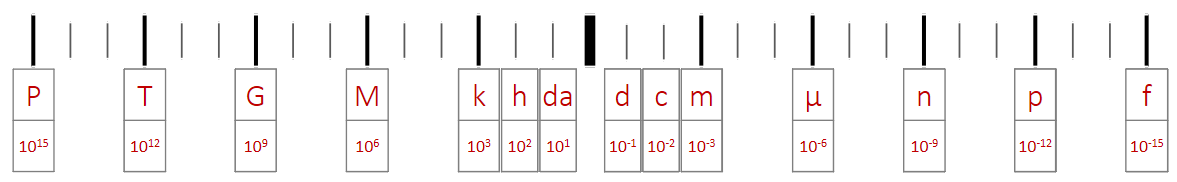
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| 1.5 – Uncertainty in Calculations |  | | | |
| I can calculate the uncertainty of an average taken from repeated measurements | |  |  |  |
| I can define and calculate absolute, fractional, and percent uncertainty | |  |  |  |
| I can determine the uncertainty when adding or subtracting two numbers | |  |  |  |
| I can determine the uncertainty when multiplying or dividing two numbers | |  |  |  |

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List the seven fundamental base units and their abbreviations:

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|  | Unit | Abbreviation |
| Length | Meter | m |
| Mass | Kilogram | kg |
| Time | Second | s |
| Electric Current | Ampere | A |
| Temperature | Kelvin | K |
| Amount of Substance | Mole | mol |
| Luminous Intensity | Candela | cd |

Metric Prefixes – List the unit prefixes in their appropriate decimal position



### Dimensional Analysis

Convert the following:

20 mi hr-1 🡪 m s-1

0.0007 km2 🡪 m2

or

Determine the units for Q:

|  |  |  |
| --- | --- | --- |
| Q = mc ΔT | m (mass) | kg |
| c (specific heat) | J kg-1 K-1 |
| ΔT (change in temp) | K |

### Error and Measurements

Define the following terms:

|  |  |
| --- | --- |
| Precision | Accuracy |
| The degree of exactness in a measurement | The closeness of a measured value to the standard |

|  |  |
| --- | --- |
| Random Error | Systematic Error |
| Imprecise measurements above or below “true” value – Human factor | Error/offset in the instrumentation used to make measurement |

Record the rules for recording measurements to the proper precision and uncertainty:

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|  | Measurement Precision | Measurement Uncertainty |
| Analog | Estimate 1 digit beyond smallest marking | ± (half the smallest division) |
| Digital | Go to the lease significant digit’s place | ± (smallest division) |

*\*the precision in the measurement and uncertainty MUST match*

### Significant Digits

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| 1. *All zeros between non-zero digits are significant* |
| 1. *Filler zeros to the left of an understood decimal place are not significant.* |
| 1. *Filler zeros to the right of a decimal place are not significant.* |
| 1. *All non-filler zeros to the right of a decimal place are significant.* |

IB grading will award full credit for answers within 1 significant digit of the actual so **round to 3 significant digits**

### Uncertainty

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| Absolute Uncertainty: | *Data Booklet Equations:* | |
| If:  Then: | Addition or subtraction: Add up the absolute uncertainties |
| Fractional Uncertainty: |
| If:  Then: | Multiplication or division: Add up the fractional or  percent uncertainties |
| Percentage Uncertainty: |