Science Skills

IB Physics Content Guide

Big Ideas

- Measurement devices are inherently uncertain, and measurement precision / uncertainty can be communicated
- The shape of a graph can lead to valuable information to gain new insights or useful models

1 – Measurements

I can describe the difference between quantitative and qualitative measurements			
I can list the 7 fundamental SI units			
I can define precision and accuracy			
I can calculate absolute, fractional, and percent uncertainty for digital and analog measurements			
I can determine the number of significant digits in a measurement			

2 – Displacement Graphs

I can describe the difference between distance and displacement			
I can calculate distance and displacement for 1D motion			
I can plot constant velocity on a displacement vs time graph			
I can plot changing velocity on a displacement vs time graph			
I can use a displacement vs time graph to identify if an object is moving in the positive or negative direction as well as if it is speeding up or slowing down			

3 – Velocity Graphs

I can describe the difference between speed and velocity			
I can compare the difference between a vector and scalar quantity			
I can plot constant velocity on a velocity vs time graph			
I can plot changing velocity on a velocity vs time graph			
I can use a velocity vs time graph to identify if an object is moving in the positive or negative direction as well as if it is speeding up or slowing down			

4 – Graphing Calculations

I can use a mathematical model to make a prediction			
I can determine the equation, values, and units for the slope of a graph			
I can determine the equation, values, and units for the area of a graph			
I can identify strategies to calculate displacement, velocity, and acceleration from a graph			

5 – Unit Analysis

I can represent fractional units with negative exponents			
I can use dimensional analysis to determine unknown units from an equation			
I can convert units using dimensional analysis (including squared and cubed units			

6 – Uncertainty Calculations

I can calculate uncertainty from added or subtracted values			
I can calculate uncertainty from multiplied or divided values			

Fundamental SI Units

	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

Error and Measurements

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

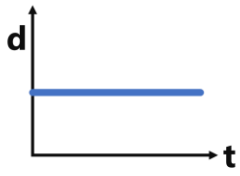
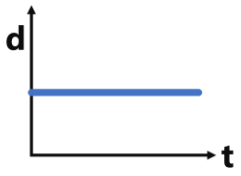
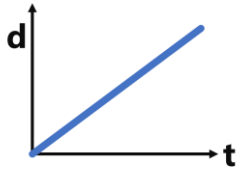
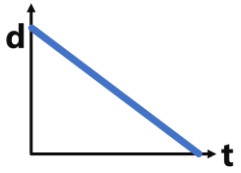
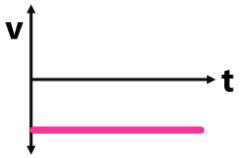
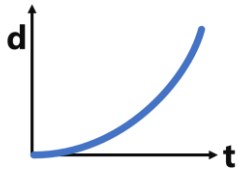
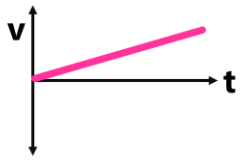
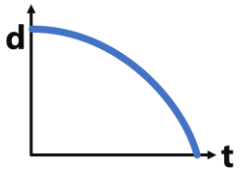
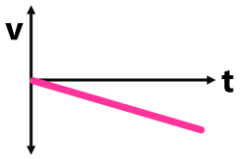
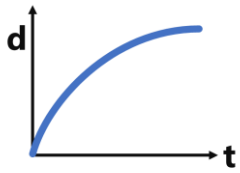
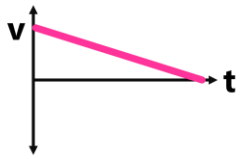
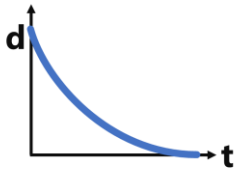
Random Error	Systematic Error
Imprecise measurements above or below "true" value – Human factor	Error/offset in the instrumentation used to make measurement

	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)

Motion Definitions

	Scalar	Vector
How far (m)	Distance	Displacement
How fast (m s^{-1})	Speed	Velocity

Motion Graphs

	Positive Direction		Negative Direction	
	Displacement	**Velocity**	**Displacement**	**Velocity**
Not Moving				
Constant Velocity				
Speeding Up				
Slowing Down				

Uncertainty Calculations

Absolute Uncertainty:

$2.0 \pm \mathbf{0.3}\ g$

Fractional Uncertainty:

$\frac{0.3}{2.0}$

Percentage Uncertainty:

$\pm\left(\frac{0.3}{2.0} \times 100\%\right)$

Data Booklet Equations:

If: $y = a \pm b$

Then: $\Delta y = \Delta a + \Delta b$

Addition or subtraction:
Add up the absolute uncertainties

If: $y = \frac{ab}{c}$

Then: $\frac{\Delta y}{y} = \frac{\Delta a}{a} + \frac{\Delta b}{b} + \frac{\Delta c}{c}$

Multiplication or division:
Add up the fractional or percent uncertainties