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| 2 | Motion | IB Physics Content Guide |

# Big Ideas

* Motion is described relative to a chosen coordinate system.
* Displacement-time, velocity-time, and accel-time graphs are connected in the representation of physical motion.
* When an object is at constant velocity, displacement-time is linear.
* When an object is at constant acceleration, displacement-time is quadratic (curved), and velocity-time is linear.
* Kinematic equations can take three of the *suvat* variables to solve for the remaining two
* Vector quantities can be combined to find resultant vectors or divided into their component parts
* X and Y motion are independent of each other for a two-dimensional projectile

# Content Objectives

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| 2.1 – Velocity |  |
| I can describe the difference between distance and displacement |  |  |  |
| I can calculate distance and displacement for 1D and 2D straight line motion |  |  |  |
| I can describe the difference between speed and velocity |  |  |  |
| I can compare the difference between a vector and scalar quantity |  |  |  |
| I can solve problems using the mathematical definition of constant velocity |  |  |  |
| I can plot constant velocity on a displacement vs time graph |  |  |  |
| I can calculate velocity from a displacement vs time graph |  |  |  |
| I can describe the difference between speed and velocity |  |  |  |

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| 2.2 – Acceleration |  |
| I can define acceleration in terms of velocity |  |  |  |
| I can graphically compare “average” and “instantaneous” velocity |  |  |  |
| I can calculate constant acceleration from a velocity vs time graph |  |  |  |
| I can calculate displacement from a velocity vs time graph |  |  |  |
| I can use the kinematic equations to solve for an unknown variable |  |  |  |
| I can describe when the kinematic equations are no longer valid |  |  |  |

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| 2.3 – Free Fall |  |
| I can identify the constant acceleration due to gravity neglecting air resistance |  |  |  |
| I can interpret a free fall problem to identify hidden values |  |  |  |
| I can use the kinematic equations to solve free fall problems |  |  |  |
| I can experimentally determine the acceleration due to gravity |  |  |  |

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| 2.4 – Graphing Motion |  |
| I can describe an object’s motion by interpreting its displacement vs time and velocity vs time graphs |  |  |  |
| I can create d vs t, v vs t, and a vs t graphs for an object in freefall |  |  |  |
| I can create a velocity vs time graph when given a displacement vs time graph |  |  |  |
| I can create a displacement vs time graph when given a velocity vs time graph |  |  |  |

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| 2.5 – Horizontal Projectiles |  |
| I can add and subtract vectors to find a resultant |  |  |  |
| I can calculate an angle from two components of a right triangle |  |  |  |
| I can calculate the x and y components of a vector given the magnitude and angle |  |  |  |
| I can identify hidden values for a horizontal projectile problem |  |  |  |
| I can use information about a horizontal projectile’s motion to calculate the initial velocity |  |  |  |
| I can use the x and y velocity components to calculate a projectile’s impact velocity and angle |  |  |  |

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| 2.6 – Projectiles at an Angle |  |
| I can identify hidden values for a projectile launched at an angle |  |  |  |
| I can calculate the x and y components for an initial velocity at an angle |  |  |  |
| I can calculate max height for a projectile launched at angle |  |  |  |
| I can calculate distance traveled for a projectile launched at angle |  |  |  |
| I can calculate total air time for a projectile launched at angle |  |  |  |

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| 2 | Motion | Shelving Guide |

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|  | Scalar | Vector |
| How far (m) | Distance | Displacement |
| How fast (m s-1) | Speed | Velocity |

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|  | Displacement vs Time | Velocity vs Time | Acceleration vs Time |
| Meaning of the Graph | Slope:Velocity | Slope: AccelerationArea under the Curve:Displacement | Area under the Curve:Velocity |
| Constant Displacement |  |  |  |
| Constant Positive Velocity |  |  |  |
| Constant Negative Velocity |  |  |  |
| Constant Positive Acceleration(speeding up) |  |  |  |
| Constant Negative Acceleration(slowing down) |  |  |  |

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|  | Variable Symbol | Unit |  | Kinematic Equations | s | u | v | a | t |
| Displacement | s | m |  | $$v=u+at$$ |  | **✔️** | **✔️** | **✔️** | **✔️** |
| Initial Velocity | u | m s-1 |  | $$s=ut+\frac{1}{2}at^{2}$$ | **✔️** | **✔️** |  | **✔️** | **✔️** |
| Final Velocity | v | m s-1 |  | $$v^{2}=u^{2}+2as$$ | **✔️** | **✔️** | **✔️** | **✔️** |  |
| Acceleration | a | m s-2 |  | $$s=\frac{\left(v+u\right)t}{2}$$ | **✔️** | **✔️** | **✔️** |  | **✔️** |
| Time | t | s |  |  |  |  |  |  |  |

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| Horizontal Component | $$A\_{H}=A\cos(θ)$$ |  |
| Vertical Component | $$A\_{V}=A\sin(θ)$$ |

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|  | Vertical |  |
| s |  |
| u | 0 m s-1 |
| v |  |
| a | -9.81 m s-2 |
| t |  |

|  |  |  |
| --- | --- | --- |
|  | Vertical |  |
| s |  |
| u | u sinθ |
| v | 0 m s-1 |
| a | -9.81 m s-2 |
| t |  |