

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

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		

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I can describe when the kinematic equations are no longer valid		

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		

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		

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		

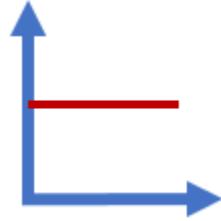
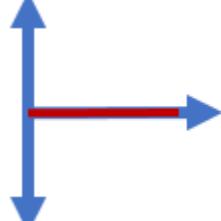
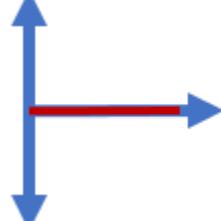
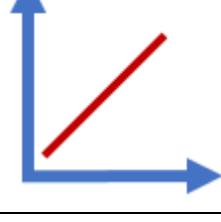
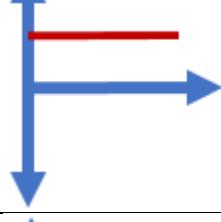
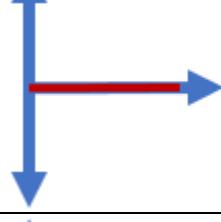
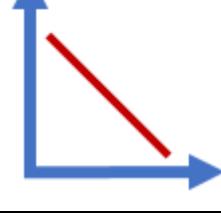
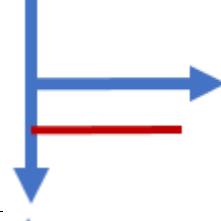
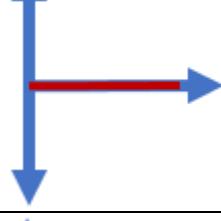
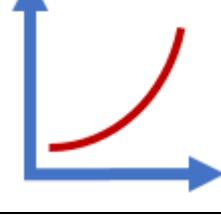
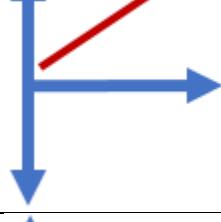
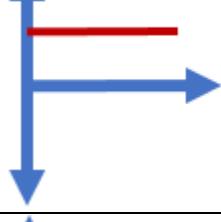
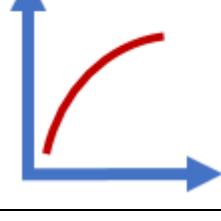
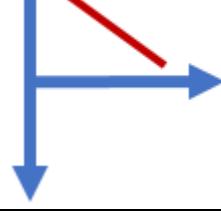
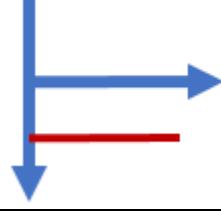
2.6 – Projectiles at an Angle

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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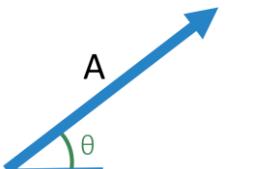
Shelving Guide

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

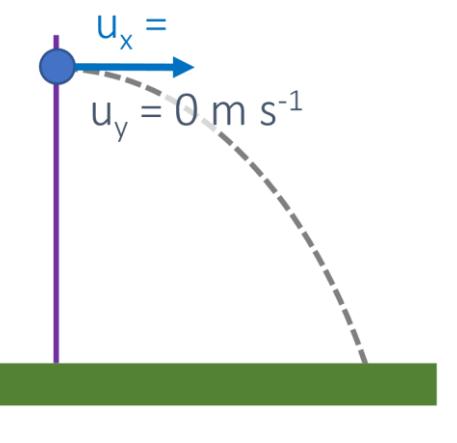
	Displacement vs Time	Velocity vs Time	Acceleration vs Time
Meaning of the Graph	Slope: Velocity	Slope: Acceleration Area under the Curve: Displacement	Area under the Curve: Velocity
Constant Displacement			
Constant Positive Velocity			
Constant Negative Velocity			
Constant Positive Acceleration (speeding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

	Variable Symbol	Unit
Displacement	s	m
Initial Velocity	u	m s^{-1}
Final Velocity	v	m s^{-1}
Acceleration	a	m s^{-2}
Time	t	s

Kinematic Equations	s	u	v	a	t
$v = u + at$		✓	✓	✓	✓
$s = ut + \frac{1}{2}at^2$	✓	✓		✓	✓
$v^2 = u^2 + 2as$	✓	✓	✓	✓	
$s = \frac{(v+u)t}{2}$	✓	✓	✓		✓

Horizontal Component	$A_H = A \cos \theta$	
Vertical Component	$A_V = A \sin \theta$	

	Vertical	
s		
u	0 m s^{-1}	
v		
a	-9.81 m s^{-2}	
t		



	Vertical	
s		
u	$u \sin \theta$	
v	0 m s^{-1}	
a	-9.81 m s^{-2}	
t		

