2 | Motion

IB Physics Content Guide

Big Ideas

- Motion is described relative to a chosen coordinate system.
- Vector quantities can be combined to find resultant vectors or divided into their component parts
- 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
- X and Y motion are independent of each other for a two-dimensional projectile

Content Objectives

2.1 – Vectors

 p. 15-22

I can describe the difference between distance and displacement			
I can calculate distance and displacement for 1D and 2D straight line motion			
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 describe the difference between distance and displacement			

2.2 – Velocity

 p. 22-27

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			

2.3 – Acceleration

 p. 24, 27-34

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I can describe when the kinematic equations are no longer valid			

2.4 – Free Fall

 p. 35-37

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			

2.5 – Graphing Motion

📖 p. 25-32

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			

2.6 – Horizontal Projectiles

📖 p. 41-44

I can recognize that the x and y-direction have different *a* values, and need to be analyzed separately			
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			

2.7 – Projectiles at an Angle

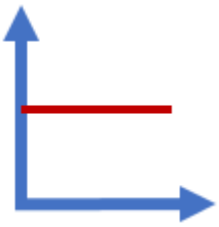
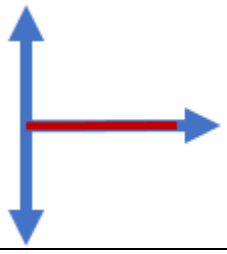
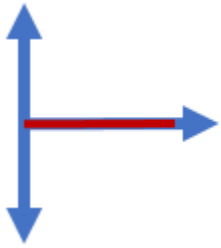
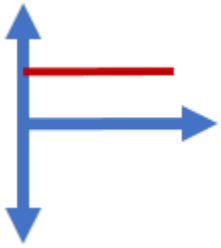
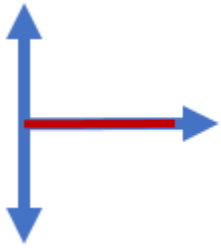
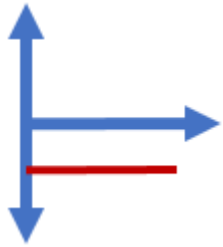
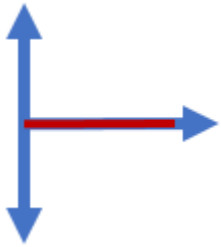
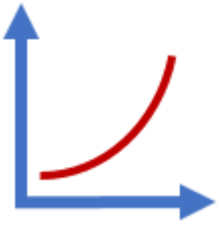
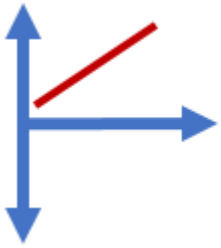
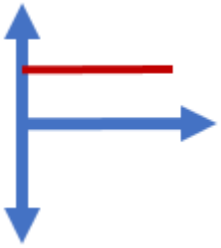
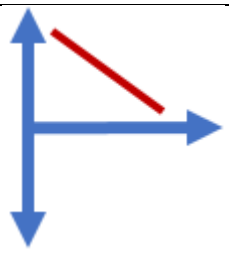
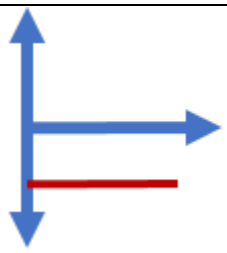
📖 p. 44-47

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			

2 | Motion

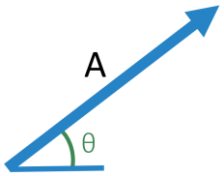
Shelving Guide

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

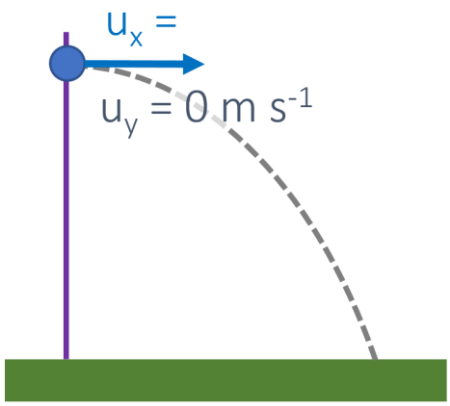
	Displacement vs Time	Velocity vs Time	Acceleration vs Time
Meaning of the Graph	Slope: Velocity	Slope: Acceleration Area under the Curve: Displacement	Area under the Curve: Velocity
Constant Displacement			
Constant Positive Velocity			
Constant Negative Velocity			
Constant Positive Acceleration (speeding 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	$A_V = A\sin\theta$	

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



	x	y
s		
u	u cosθ	u sinθ
v		0 m s^{-1}
a	0 m s^{-2}	-9.81 m s^{-2}
t