3 | Forces

IB Physics Content Guide

Big Ideas

- Many forces acting on an object can be simplified down into one net force
- Acceleration is zero when net force is zero (could mean stopped or constant velocity)
- If you have the acceleration of an object, you can find the net force causing that acceleration and vice versa
- Force of friction is related to the normal reaction force
- For objects on aa sloped surface, the weight must be broken down into its perpendicular and parallel component

Content Objectives

3.1 – Newton's First Law and Free Body Diagrams

 p. 15-22

I can define a force (with proper units) in terms of the interaction between two objects			
I can describe Newton's first law			
I can calculate the net force on an object			
I can calculate an unknown force for an object in equilibrium			

3.2 – Newton's Second Law

 p. 47-51, 63-65

I can define and calculate momentum			
I can describe Newton's second law in terms of momentum			
I can calculate force given mass and acceleration and calculate acceleration given force and mass			
I can combine Newton's second law with the kinematic equations to solve force/motion problems			
I can calculate the weight of an object			
I can describe the difference between mass and weight			
I can use Newton's third law to describe how to find the normal reaction force with force pairs			
I can draw a free body diagram with weight, normal reaction force, friction, and any other forces			
I can explain the connection between constant velocity and balanced forces			

3.3 – Calculating Friction and Air Resistance

 p. 52, 59-62

I can calculate the force of friction when given the reaction force and coefficient of friction			
I can quantitatively compare surfaces based on their coefficients of friction			
I can calculate the acceleration of an object with friction based on the external force and mass			
I can describe the factors that affect air resistance and how the resistance changes with velocity			
I can describe terminal velocity with graphs and free body diagrams			

3.4 – Force on a Ramp

 p. 59-62

I can calculate parallel and perpendicular components of the force due to gravity on a ramp			
I can calculate the force of friction required to keep an object in equilibrium			
I can calculate the acceleration of an object with known mass on a ramp of known angle and friction			
I can calculate parallel and perpendicular components of the force due to gravity on a ramp			

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Shelving Guide

Type of Force	Variable	Description/Important Properties	Equation
	F_g		
	F_T		
	R		
	F_f		
	F_{air}		

If an object has a net force of zero its motion is either:

	or	

Newton's Laws

Newton's First Law	
Newton's Second Law	
Newton's Third Law	

Data Booklet Equations:

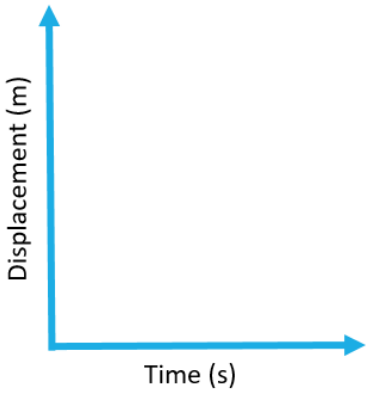
$F = ma$

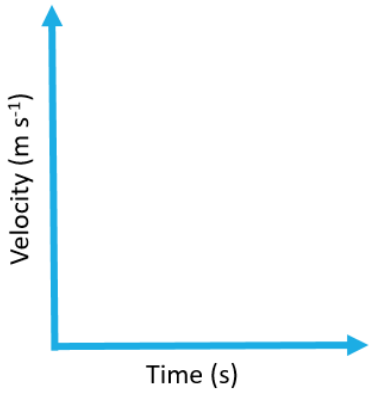
$F_f \leq \mu_s R$

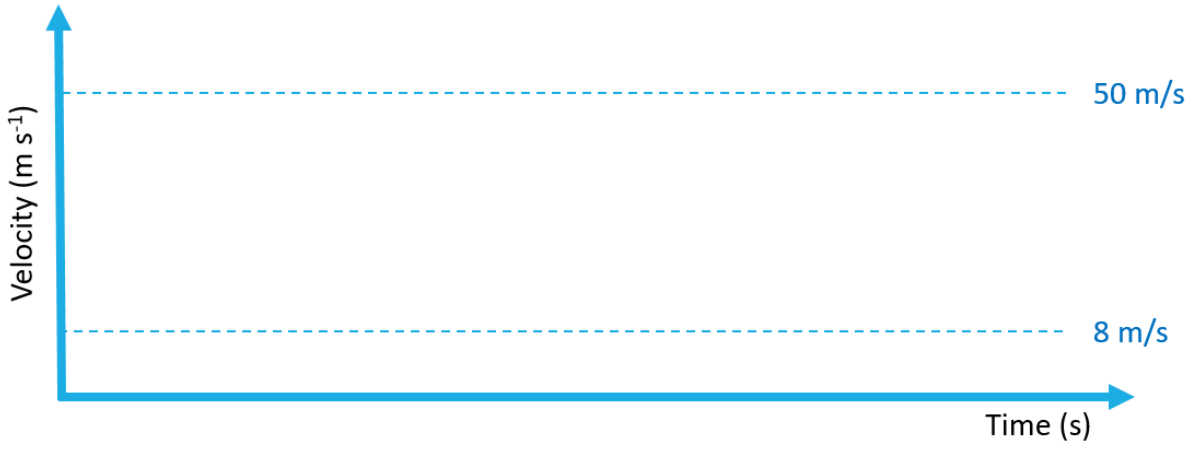
$F_f = \mu_d R$

	Variable Symbol	Unit
Force		
Mass		
Acceleration		
Normal Reaction Force		
Coefficient of Kinetic Friction		
Coefficient of Static Friction		

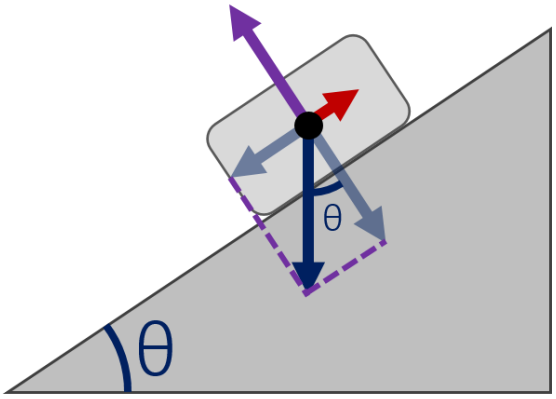
Terminal Velocity	







Sliding to a Stop	Constant Velocity	
F_{net} =	F_{net} =	F_{pull} =



$F_{\perp}$	
$F_{\parallel}$	

Forces on a Ramp

Equilibrium	
R	
F_f	
F_{net}	
a	

Accelerating	
R	
F_f	
F_{net}	
a	