Forces

IB Physics Content Guide

Big Ideas

- Many forces acting on an object can be simplified down into one net force
- For objects in equilibrium, all the forces cancel out for a net force of 0 N
- The magnitude of some forces depends on other forces (i.e. friction depends on normal force)

1 – Equilibrium

I can define a force (with proper units) in terms of the interaction between two objects			
I can calculate the resultant vector for 2 vectors in one dimension or at right angles			
I can calculate the net force on an object			
I can calculate an unknown force for an object in equilibrium			
I can describe Newton's first law			

2 – Types of Forces

I can calculate the weight of an object			
I can describe the difference between mass and weight			
I can use a diagram to identify the direction of tension and normal forces			
I can draw a free body diagram with weight, normal force, friction, and any other forces			
I can describe how the stretch of a spring and its elastic force are related by a spring constant			
I can calculate spring constant through an equation or Force vs Distance graph			
I can explain how the direction of an elastic force is related to the deflection of the spring			

3 – Friction and Ramps

I can calculate the force of friction when given the normal force and coefficient of friction			
I can quantitatively compare surfaces based on their coefficients of friction			
I can describe how the normal force is impacted by an inclined surface			
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 on a ramp			

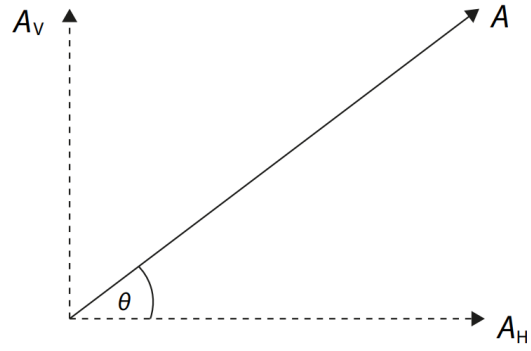
4 – Buoyant Force

I can describe and calculate an object's density when related to mass and volume			
I can determine the amount of liquid displaced by an object placed into a container			
I can calculate the buoyant force on an object placed surrounded by a fluid of known density			
I can predict whether an object will float or sink based on the buoyant force and weight			
I can analyze situations where objects are floating when only partially submerged			
I can find the forces (tension or normal) required to keep a submerged object in equilibrium			

Name of Force	Variable	Description/Important Properties	Equation
	F_g		
	F_T		
	F_N		
	F_H		
	F_f		
	F_b		

Geometry Review

Vectors



$A_H = Acos\theta$
$A_V = Asin\theta$
${A_H}^2 + {A_V}^2 = A^2$

Volume

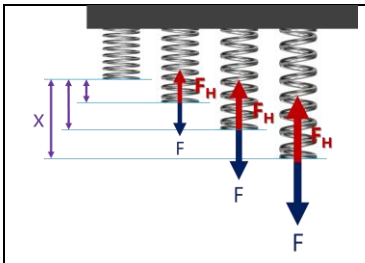
Volume of a cuboid	$V = lwh$ where l is the length, w is the width, h is the height
Volume of a cylinder	$V = \pi r^2 h$
Volume of a prism	$V = Ah$ where A is the area of cross-section
Volume of a sphere	$V = \frac{4}{3}\pi r^3$

Weight

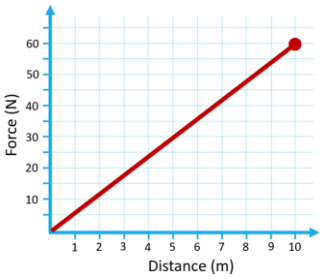
	Variable Symbol	Description	Unit
$F_g = mg$	F_g		
	m		
	g		

Elastic Force

	Variable Symbol	Description	Unit
$F_H = -kx$	F_H		
	k		
	x		



Calculate k (with units) from graph

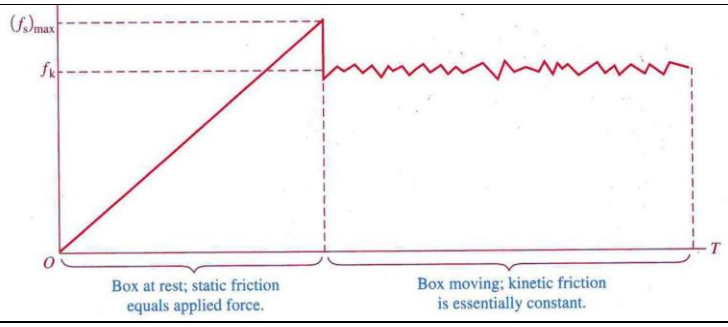


What does the negative mean?

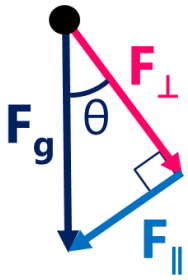
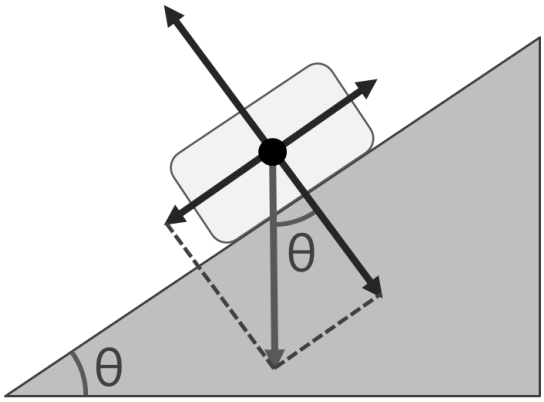
$F_H = -kx$

Friction

	Variable Symbol	Description	Unit
$F_f \leq \mu_s F_N$ $F_f = \mu_d F_N$	F_f		
	μ_s		
	μ_d		
	F_N		

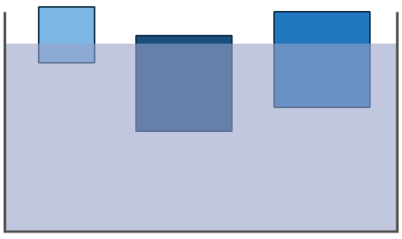
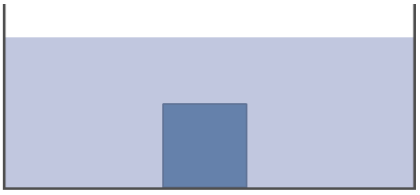
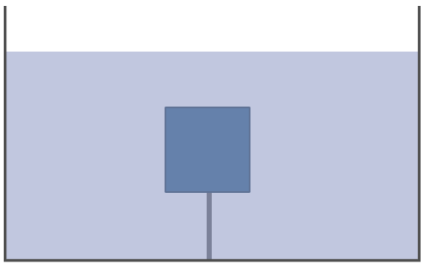
Static Friction	Dynamic Friction	
		

Ramps

Label me:	F_g =	
	$F_{\parallel}$ =	
	$F_{\perp}$ =	
	F_N =	
	F_f =	

Buoyant Force

	Variable Symbol	Description	Unit
$\rho = \frac{m}{V}$	ρ		
	m		
	V		

	Variable Symbol	Description	Unit
$F_b = \rho V g$	F_b		
	ρ		
	V		
	g		

Floating	Resting on Bottom	Tethered to Bottom