Virtual Learning

Physics

Newton's Laws of Motion Sim Part II

April 22, 2020

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Newton's Laws of Motion Sim Part II: April 22, 2020

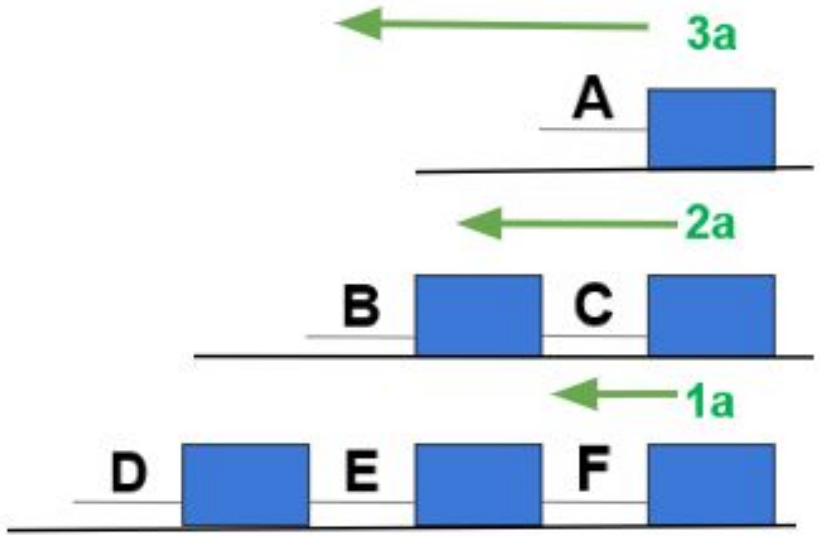
Objective/Learning Target:

Students will use a computer simulation to examine Newton's Laws of Motion.

Quick Review #1

The boxes on the right are being pulled by a rope along a frictionless surfaces, accelerating towards the left. All of the boxes are identical, and the accelerations of the boxes are indicated by the green arrows.

Rank from the largest to the smallest, the magnitude of the tensions in the labeled ropes.



Quick review #1 Answer

Newton's 2nd Law holds the key.

F(Tension) = ma

<u>Tension Values</u>:

A = m3a = 3ma

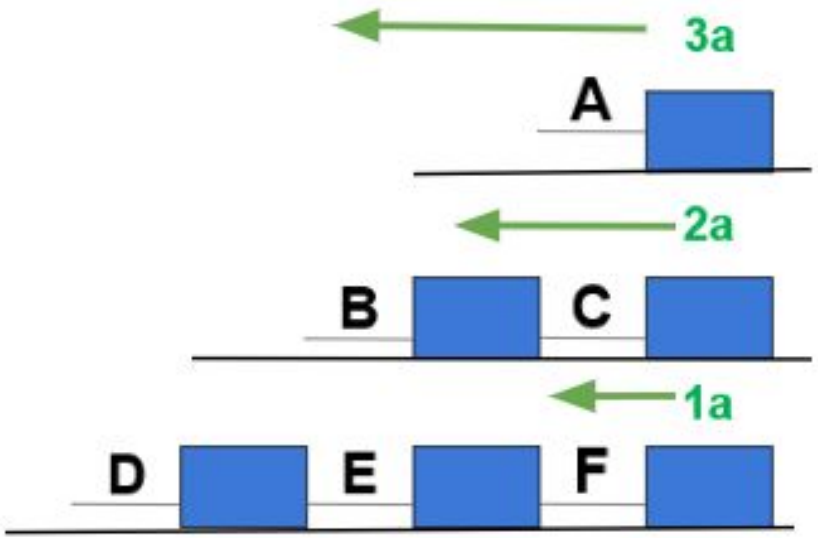
B = 2m2a = 4ma

C = m2a = 2ma

D = 3m1a = 3ma

E = 2m1a = 2ma

F = 1m1a = ma



B>A=D>C=E>F

Quick Review #2

a. If a Semi-truck and small sports car have a head-on collision, upon which vehicle is the impact force greater? Explain.
b. Which vehicle experiences the greater deceleration? Explain.

Quick Review #2

a. According to Newton's 3rd law, the force is the same for both vehicles!

b. The sports car experiences greater de-acceleration because it has less mass. Newton's 2nd law (F=ma) can be rewritten to read a=F/m. For the same force the acceleration is inversely proportional to the mass. Hence the lower mass object (the sports car) experiences greater acceleration which in this case is actually de-acceleration.

Newton's Laws of Motion

Introduction

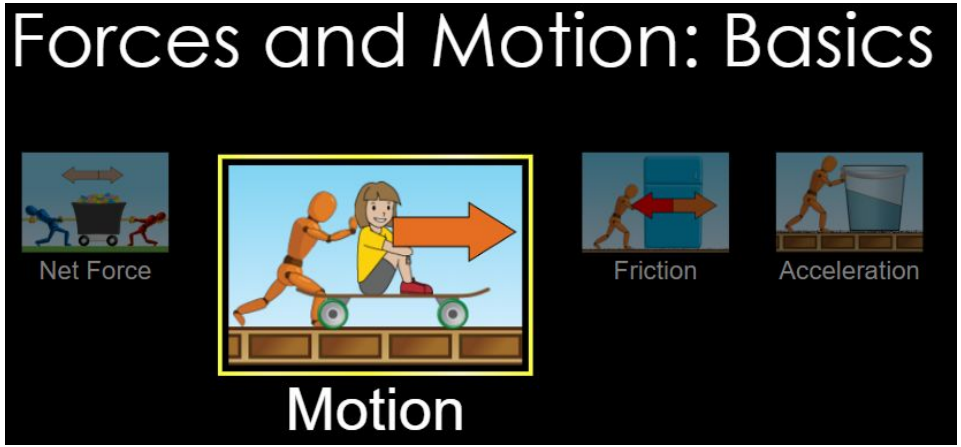
You will use a computer simulation today to reinforce your ideas of Newton's Laws of Motion. Since this is "inquiry based", you're not supposed to know everything going in, but learn as we walk through the lesson. **You must read the following slides carefully.** Let's get started!

Newton's 2nd Law of Motion

Website:[Force and Motion Computer Simulation]

Make sure to use the HTML5 version.

Select the motion icon and double click to start.



Newton's 2nd Law of Motion

Make sure the boxes that say "Force", "Values" and "Speed" are checked!

Press the pause button before setting your parameters. Once set push play.

Newton’s 2nd Law of Motion

Reset the sim, don’t forget to check force, values and speed again.

Remove the box and place a garbage can on top of the skateboard. Using your timer/phone, measure the amount of time it takes to reach maximum speed using a force of 50N. Try this again with forces of 100N, 150N, 200N and 250N.

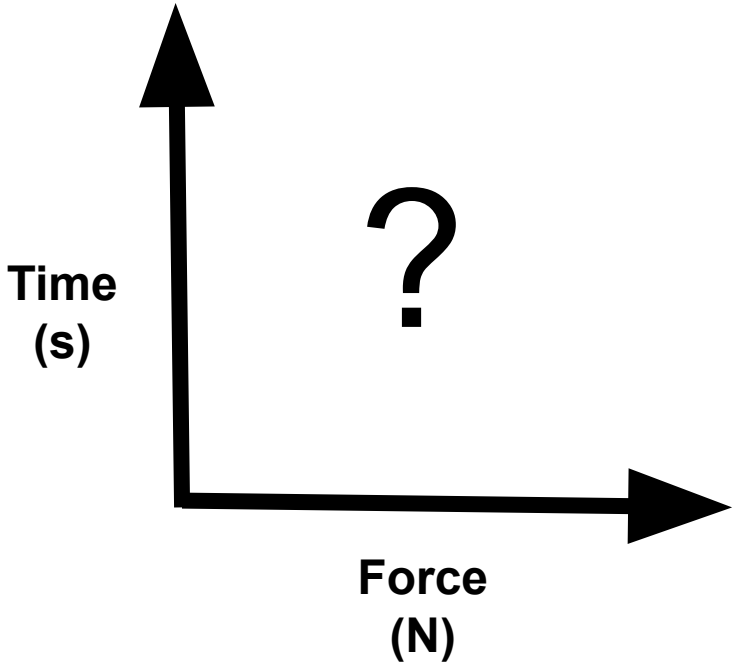
Applied Force (N)	Time To Max Speed (s)
50	
100	
150	
200	
250	

Newton's 2nd Law of Motion

Construct a time to reach max speed vs. applied force graph.

Plot points and draw a line of best fit.

Describe the relationship between time and applied force as shown in the graph.



Newton's 2nd Law of Motion

Reset the sim, check force, values, speed and the masses boxes this time.

Set the applied force to 200 N Right. Using your timer/phone measure the amount of time it takes to reach maximum speed for varying masses.

Use the objects in the sim to match the masses in the data table. Record your findings!

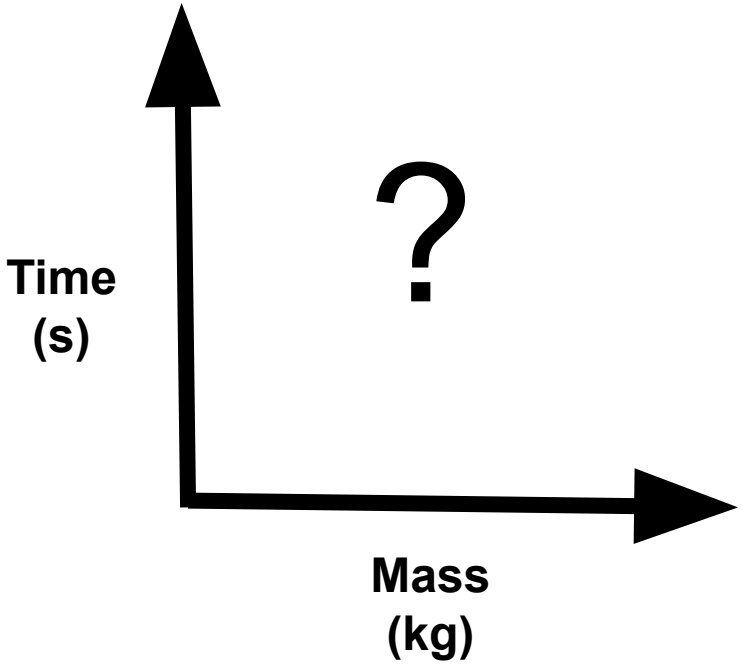
Objects Mass (kg)	Time To Max Speed (s)
50	
100	
150	
200	
250	

Newton's 2nd Law of Motion

Construct a time to reach max speed vs. applied force graph.

Plot points and draw a line of best fit.

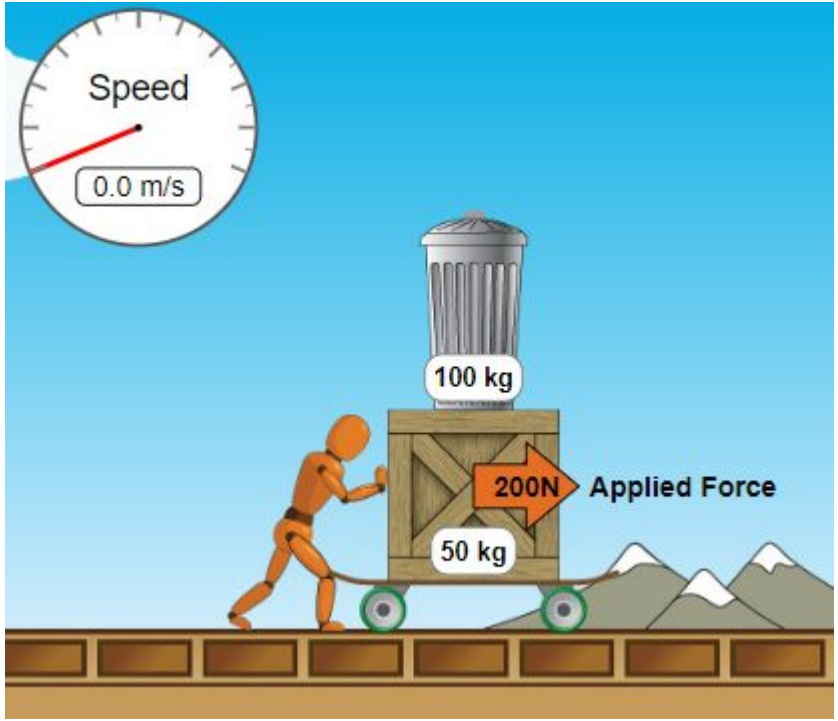
Describe the relationship between time and the objects' mass as shown in the graph.



Newton’s 2nd Law of Motion Summary

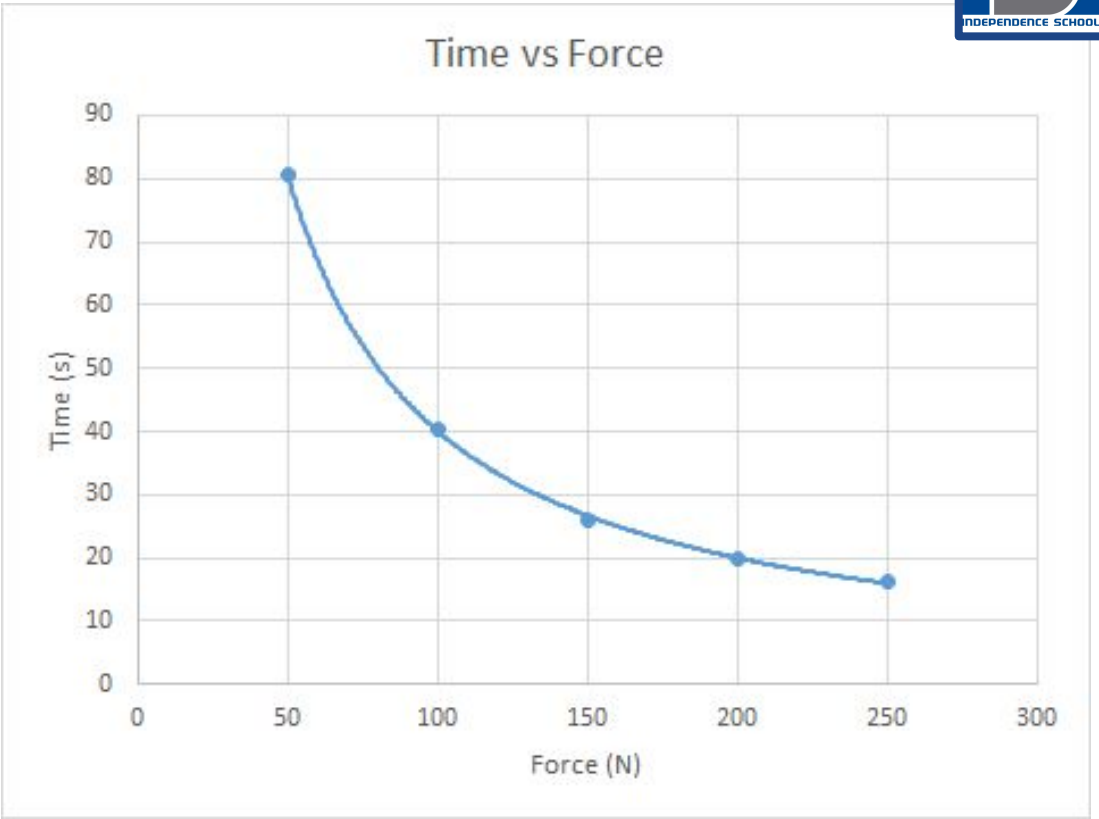
Newton’s Second Law states “The acceleration of an object as produced by a net force is directly proportional to the magnitude of the net force, in the same direction as the net force, and inversely proportional to the mass of the object.”

Explain how your observations in both experiments support this Law.



Time vs Applied Force Answer

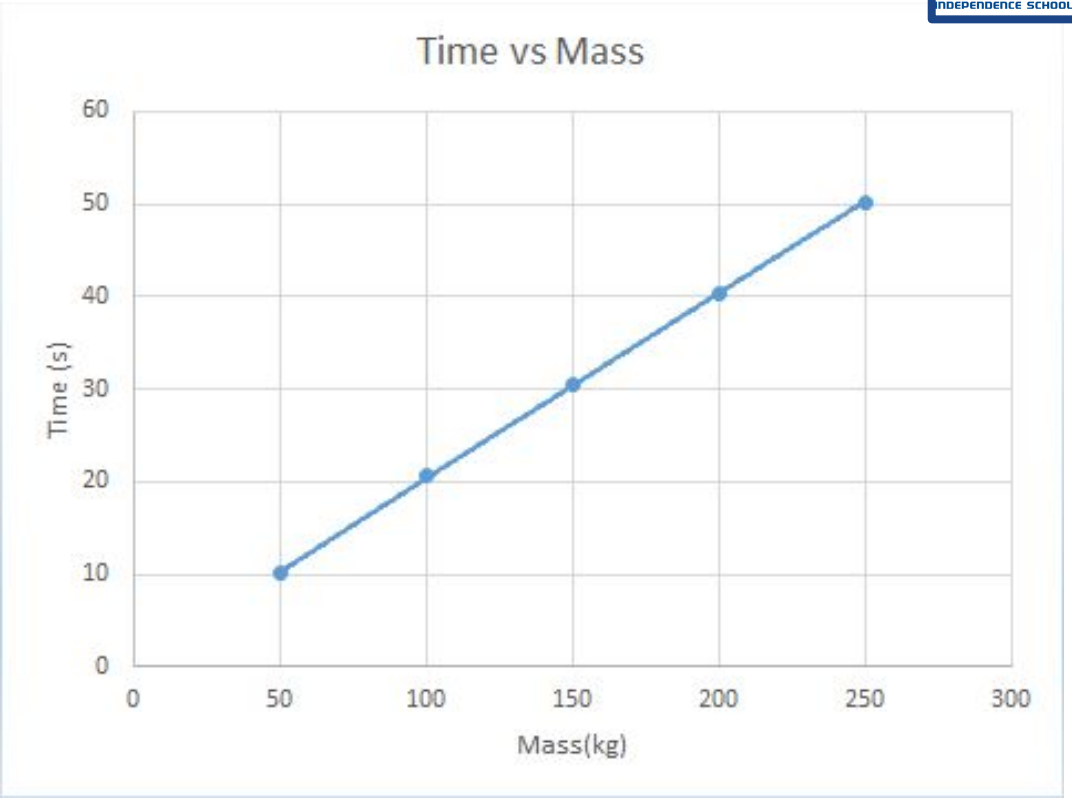
Applied Force (N)	Time To Max Speed (s)
50	80.6
100	40.5
150	26.06
200	20.00
250	16.22



As the force increased the amount of time to reach max speed decreased.

Time vs Mass of Object Answer

Objects Mass (kg)	Time To Max Speed (s)
50	10.2
100	20.6
150	30.5
200	40.3
250	50.1



As the mass increased the amount of time to reach max speed also increased.

Newton’s 2nd Law of Motion Summary Answer

In part one the force increased which caused the acceleration to increase as was evident by the decreased time to reach 40 m/s^2.

In part two as the mass increased the acceleration decreased as was evident by the longer time to reach 40 m/s^2.

So this activity directly proved that Newton’s 2nd Law of Motion is valid.

Additional Practice

Visit the Physics Classroom Website for further explanation and some practice problems

Physics Classroom - Newton's 2nd Law