

Solving Dynamics Problems

Example 1

A 20 kg box is pulled across a horizontal surface by a 10 N force parallel to the surface. If the box starts from rest, how long will it take to reach a velocity of 6.5 m/s

Example 2

A 20 kg box is pulled across a horizontal surface by a 10 N force applied at an angle of 60° above the horizontal. If the box starts from rest, how far will it have moved after 8.3 s ?

Example 3

A 20 kg box is pulled across a horizontal surface by a 30 N force directed East and a 40 N force directed North. Determine the magnitude and direction of the acceleration of the box.

Dynamics Worksheet #1

In each of the following questions, frictional effects may be disregarded. Your solution for each question should include a free body diagram and all of your work.

- An object with a mass of 15 kg rests on a frictionless horizontal plane and is acted upon by a horizontal force of 30 N .
 - What is its acceleration? (2 m/s^2)
 - How far will it move in 10 s ? (100 m)
 - What will be its velocity after 10 s assuming it starts from rest? (20 m/s)
- A car with a mass of 1000 kg is moving in a straight line at a constant speed of 30 m/s . It is brought to rest in 25 s . What constant force is acting to stop the car? (-1200 N)
- Forces of 100 N [N] and 80 N [W] act simultaneously on an object of mass 10 kg . What is the acceleration of the object? (12.8 m/s^2 [$51^\circ N$ of W])
- An empty railway car of mass 15000 kg is being pulled along a smooth, horizontal track by a tractor traveling on a road parallel to the track. The rope joining the tractor and the railway car makes an angle of 25° with the track.
 - If the acceleration of the railway car is 0.80 m/s^2 , what is the force exerted by the rope on the railway car? (13240.5 N)
 - Why does the railway car have no sideways motion?
- Two girls, one of mass 40 kg and the other of mass 60 kg , are standing side by side in the middle of a frozen pond. One pushes the other with a force of 360 N for 0.10 s . The ice is essentially frictionless.
 - What is each girl's acceleration? (9 m/s^2 , -6 m/s^2)
 - What velocity will each girl acquire in the 0.10 s that the force is acting? (0.9 m/s , -0.6 m/s)
 - How far will each girl move during the same time period? (0.045 m , -0.03 m)

6. **(Challenging)** A man drags a package across the floor with a force of 40 N directed at an angle θ to the horizontal. The mass of the package is 10 kg . If the acceleration of the package is 3.5 m/s^2 , and friction can be neglected, what is θ ? (29°)
7. **(Challenging)** Two crates, of mass 12 kg and 20 kg , respectively, are pushed across a frictionless floor together, the 20 kg crate in front of the 12 kg crate. Their acceleration is $+9.0\text{ m/s}^2$. Calculate each of the following.
- The force applied to push the crates. (288 N)
 - The action-reaction forces between the two crates (in other words, the force exerted by each crate on the other). (180 N)