All Assignments

Help

HW #3: Newton's Laws

Edit

Overview Diagnostics Print View with Answers

HW #3: Newton's Laws

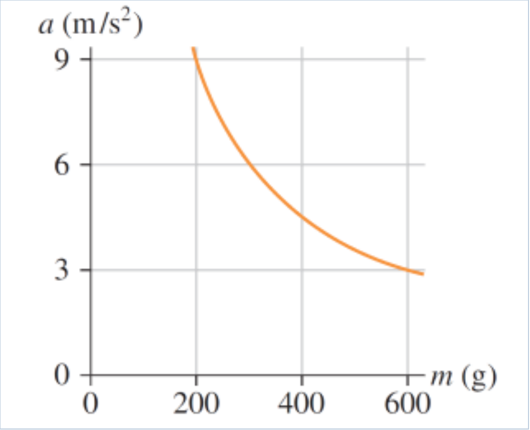
Due: 11:59pm on Wednesday, September 25, 2024

You will receive no credit for items you complete after the assignment is due. Grading Policy

Problem 5.15 - Enhanced - with Expanded Hints

Description: [[Enhanced item has hints walking students through the problem-solving steps. All parts and hints contain wrong answer feedback, with a worked solution available upon completing the part.]] shows the acceleration of objects of different mass that...

shows the acceleration of objects of different mass that experience the same force.



Part A

What is the magnitude of the force?

Express your answer to two significant figures and include the appropriate units.

Hint 1. How to approach the problem

The force exerted on an object is related to the acceleration and mass of the object by Newton's second law.

Hint 2. Simplify: points on the graph

What is the mass of an object which gets an acceleration of 6 $\mathrm{m/s^2}$?

Express your answer in kilograms.

ANSWER:

$m_{6\ \mathrm{m/s^2}}$ = 0.300 kg

ANSWER:

F = 1.8N

Also accepted: 1.80N, 1.8N

Newton's second law is $F = ma$. The graph shows the acceleration as a function of mass. The force can be derived from the mass and acceleration for any given point. For example, for a mass of m = 200 g = 0.20 kg, the acceleration is a = 9.0 $\mathrm{m/s^2}$.

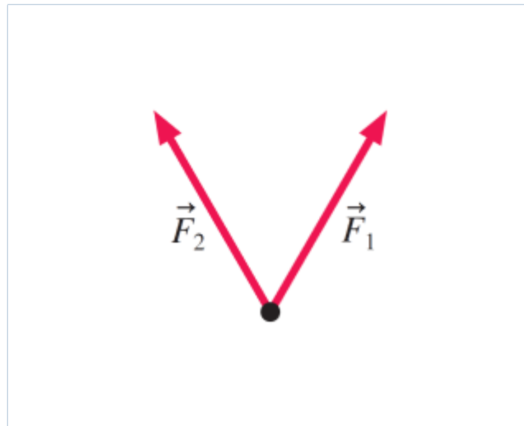
$F = ma = (0.20\ \mathrm{kg})(9.0\ \mathrm{m/s^2}) = 1.8\ \mathrm{N}$

Any other point of the graph will result in the same answer.

Problem 5.19

Description: shows two of the three forces acting on an object in equilibrium. (a) Redraw the diagram, showing all three forces. Label the third force F_vec_3.

shows two of the three forces acting on an object in equilibrium.



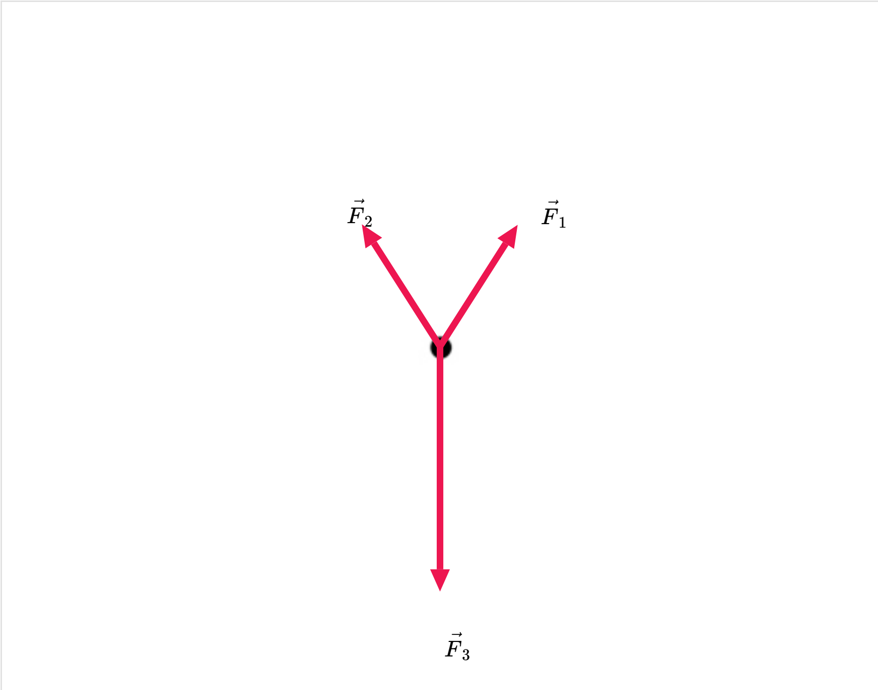
Part A

Redraw the diagram, showing all three forces. Label the third force $\vec{F}_3$.

Draw the vectors starting at the black dots. The location, orientation, and length of the vector will be graded. You can move the vectors $\vec{F}_1$ and $\vec{F}_2$ to construct the required vector, but be sure to return them into their initial positions before submitting the answer.

ANSWER:

No elements selected



Problem 6.16

Description: The position of a ## kg mass is given by [...] m, where t is in seconds. (a) What is the net horizontal force on the mass at t =0 s? (b) What is the net horizontal force on the mass at t =1 s?

The position of a 1.2 kg mass is given by $x = (2t^3 - 5t^2)\ \mathrm{m}$, where t is in seconds.

Part A

What is the net horizontal force on the mass at $t = 0\ \mathrm{s}$?

Express your answer with the appropriate units.

ANSWER:

F = $-2am$ = -12N

Part B

What is the net horizontal force on the mass at $t = 1\ \mathrm{s}$?

Express your answer with the appropriate units.

ANSWER:

$F = m(12 - 2a) = 2.4\,\mathrm{N}$

Problem 6.21 - Enhanced - with Hints and Feedback

Description: A ## kg rocket has a rocket motor that generates ## N of thrust. (a) What is the rocket's initial upward acceleration? (b) At an altitude of 5000 m the rocket's acceleration has increased to ## m/s^2. What mass of fuel has it burned?

A 2.0×10^4 kg rocket has a rocket motor that generates 3.0×10^5 N of thrust.

Part A

What is the rocket's initial upward acceleration?

Express your answer with the appropriate units.

Hint 1. How to approach the question

Two forces act on the rocket: gravitational force and thrust. Determine the net force and apply Newton's second law to calculate acceleration.

ANSWER:

$a = \frac{F}{m} - 9.8 = 5.2\,\frac{\mathrm{m}}{\mathrm{s}^2}$

Also accepted: $\frac{F}{m} - 9.8 = 5.20\,\frac{\mathrm{m}}{\mathrm{s}^2}$, $\frac{F}{m} - 9.8 = 5.2\,\frac{\mathrm{m}}{\mathrm{s}^2}$

Part B

At an altitude of 5000 m the rocket's acceleration has increased to 7.5 $\mathrm{m/s^2}$. What mass of fuel has it burned?

Express your answer with the appropriate units.

Hint 1. How to approach the question

Write Newton's second law for the rocket at an altitude of 5000 m and express the rocket's mass from it. Compare the found value to the initial mass of the rocket to find the mass of burned fuel.

ANSWER:

$m_{fuel} = m - \frac{F}{a+9.8} = 2700\,\mathrm{kg}$

Also accepted: $m - \frac{F}{a+9.8} = 2660\,\mathrm{kg}$, $m - \frac{F}{a+9.8} = 2700\,\mathrm{kg}$

Problem 6.25

Description: Bonnie and Clyde are sliding a m bank safe across the floor to their getaway car. The safe slides with a constant speed if Clyde pushes from behind with Fc of force while Bonnie pulls forward on a rope with Fb of force. (a) What is the safe's...

Bonnie and Clyde are sliding a 315 kg bank safe across the floor to their getaway car. The safe slides with a constant speed if Clyde pushes from behind with 371 N of force while Bonnie pulls forward on a rope with 363 N of force.

Part A

What is the safe's coefficient of kinetic friction on the bank floor?

ANSWER:

$\frac{\frac{Fc+Fb}{m}}{9.80}$ = 0.238

Problem 6.27 - Enhanced - with Expanded Hints

Description: [[Enhanced item has hints walking students through the problem-solving steps. All parts and hints contain wrong answer feedback, with a worked solution available upon completing the part.]] Bob is pulling a ## kg filing cabinet with a force of ## N,...

Bob is pulling a 30 kg filing cabinet with a force of 200 N, but the filing cabinet refuses to move. The coefficient of static friction between the filing cabinet and the floor is 0.80.

Part A

What is the magnitude of the friction force on the filing cabinet?

Express your answer with the appropriate units.

Hint 1. How to approach the problem

The problem states that after applying a force of 200 N on the cabinet, it still doesn't move. The best way to set up this problem is to make a simple force diagram of the cabinet, along with the known values. Considering that the cabinet doesn't move, you can get all the information needed by writing down the expression for the net force on the cabinet.

Hint 2. Simplify: determining the net force

The most important part of solving this problem is determining the value of the net force acting on the cabinet.

As the cabinet stays at rest, what is the sum of all forces acting on it?

Express your answer with the appropriate units.

ANSWER:

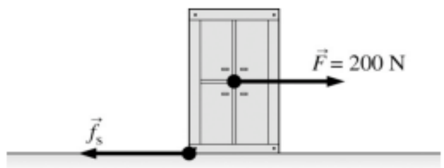
F_{net} = 0N

ANSWER:

f = F = 200N

MODEL: Model the cabinet as a particle.

VISUALIZE: Consider the figure below. In equilibrium, the net force is zero.



SOLVE: The cabinet is in static equilibrium, so the static frictional force must have the same magnitude as Bob's pulling force: $200\ \mathrm{N}$.

REVIEW: A possible misconception is that $f_s = \mu n$ always. That value is the maximum possible value. If Bob pulled harder and harder and got up to $\mu n = 235\ \mathrm{N}$ then the cabinet would move. But the static frictional force can easily be less than this value.

Problem 6.32 - Enhanced - with Hints and Feedback

Description: You and your friend Peter are putting new shingles on a roof pitched at ## ! degree(s)! . You're sitting on the very top of the roof when Peter, who is on the edge of the roof, ## m away, asks you for the box of nails. Rather than carry the ## kg box...

You and your friend Peter are putting new shingles on a roof pitched at 20°. You're sitting on the very top of the roof when Peter, who is on the edge of the roof, 5.4 m away, asks you for the box of nails. Rather than carry the 2.1 kg box of nails down to Peter, you decide to give the box a push and have it slide down to him.

Part A

If the coefficient of kinetic friction between the box and the roof is 0.55, with what speed should you push the box to have it gently come to rest right at the edge of the roof?

Express your answer with the appropriate units.

Hint 1. How to approach the problem

Three forces act on the box as it slides down the roof: gravitational force, friction force, and normal force. Establish a coordinate system and write Newton's second law in component form. Solving two equations simultaneously you can determine the acceleration of the box. Then apply the constant-acceleration kinematic equation to determine the initial speed.

ANSWER:

$v = \sqrt{2 \cdot 9.8 \left(\mu_k \cos(\theta) - \sin(\theta)\right) d} = 4.3 \frac{\mathrm{m}}{\mathrm{s}}$

Problem 6.48 - Enhanced - with Hints and Feedback

Description: An object of mass m is at rest at the top of a smooth slope of height h and length L. The coefficient of kinetic friction between the object and the surface, mu_k, is small enough that the object will slide down the slope if given a very small push to ...

An object of mass m is at rest at the top of a smooth slope of height h and length L. The coefficient of kinetic friction between the object and the surface, μ_k, is small enough that the object will slide down the slope if given a very small push to get it started.

Part A

Find an expression for the object's speed at the bottom of the slope.

Express your answer in terms of the variables m, μ_k, L, h, and appropriate constants.

Hint 1. How to approach the question

Establish a coordinate system with one axis parallel to the slope and another perpendicular to it. Write Newton's second law in component form and determine the acceleration along the slope from it. Then you can apply the constant-acceleration kinematic equation to find the speed at the bottom of the slope.

ANSWER:

$v = \sqrt{2g\left(h - \mu_k\sqrt{L^2 - h^2}\right)}$

Part B

Sam, whose mass is 80 kg , stands at the top of a 10-m-high, 110-m-long snow-covered slope. His skis have a coefficient of kinetic friction on snow of 0.07. If he uses his poles to get started, then glides down, what is his speed at the bottom?

Express your answer with the appropriate units.

Hint 1. How to approach the question

Substitute the given values into the expression for speed found in the previous part.

ANSWER:

$v = \sqrt{2 \cdot 9.8\left(h - 0.07\sqrt{L^2 - h^2}\right)}$ = 6.8 $\frac{\mathrm{m}}{\mathrm{s}}$

Problem 6.54

Description: A large box of mass M is pulled across a horizontal, frictionless surface by a horizontal rope with tension T. A small box of mass m sits on top of the large box. The coefficients of static and kinetic friction between the two boxes are mu_s and mu_k, ...

A large box of mass M is pulled across a horizontal, frictionless surface by a horizontal rope with tension T. A small box of mass m sits on top of the large box. The coefficients of static and kinetic friction between the two boxes are μ_s and μ_k, respectively.

Part A

Find an expression for the maximum tension T_{max} for which the small box rides on top of the large box without slipping.

Express your answer in terms of the variables M, m, μ_s, and appropriate constants.

ANSWER:

$T = (M + m)\mu_s g$

Part B

A horizontal rope pulls a 12 kg wood sled across frictionless snow. A 5.4 kg wood box rides on the sled. What is the largest tension force for which the box doesn't slip? Assume that $\mu_s = 0.50$.

Express your answer with the appropriate units.

ANSWER:

$T = (M+m)\cdot 0.5\cdot 9.8 = 85\,\mathrm{N}$

Physics for Scientists and Engineers with Modern Physics, 5e
Knight
amundson44156
Ends: 12/21/24