

1 point(s)

Newton's Second and Third Law 1

You are standing on the side of a hill. Which of the following is true?

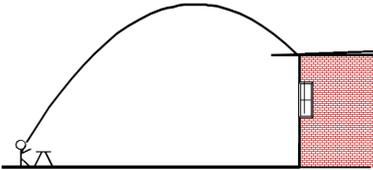
- A. The magnitude of the normal force from the ground on you is greater than the magnitude of your weight because of Newton's third law.
- B. The magnitude of the normal force from the ground on you is greater than the magnitude of your weight because of Newton's second law.
- C. The magnitude of the normal force from the ground on you is equal to the magnitude of your weight because of Newton's third law.
- D. The magnitude of the normal force from the ground on you is less than the magnitude of your weight because of Newton's second law.
- E. The magnitude of the normal force from the ground on you is equal to the magnitude of your weight because of Newton's second law.

Tries 0/15

1 point(s)

Stepping Up To Throw

An angry person is throwing rocks onto a shed with a flat, horizontal roof as shown. If the angry person throws an identical rock with the same initial speed and a slightly larger angle from the horizontal, how will this affect the magnitudes of the horizontal and vertical components of the velocity of the rock as it hits the roof of the shed?



- A. The horizontal component will decrease and the vertical component will increase.
- B. The horizontal component will increase and the vertical component will decrease.
- C. The horizontal component will decrease and the vertical component will decrease.
- D. The horizontal component will increase and the vertical component will increase.
- E. There is not enough information to tell.

Tries 0/15

1 point(s)

Static Friction Conceptual Question

A block is sitting on a beam which is initially horizontal. One end of the beam is slowly lifted so that the beam makes an angle with the horizontal that is increasing at a steady rate. If the block does not slide during the time period under consideration, which of the following is correct?

- A. The force of static friction decreased and the maximum possible force of static friction remained the same.
- B. The force of static friction increased and the maximum possible force of static friction decreased.
- C. There is not enough information given to determine which of these is correct.
- D. The force of static friction increased and the maximum possible force of static friction remained the same.
- E. The force of static friction increased and the maximum possible force of static friction increased.

Tries 0/15

1 point(s)

Newton's 1st Law Question w/ Rider in Accelerating Car

You are riding in a sealed train car. You observe a pendulum hanging from the ceiling deflected away from the front of the train. Which of the following conclusions is definitely incorrect?

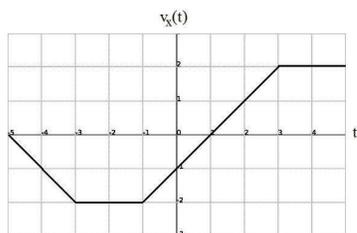
- A. The train is moving up a hill at a constant velocity.
- B. The train is moving down a hill and speeding up.
- C. The train is on level ground, moving forward and speeding up.
- D. The train is on level ground and moving at a rapid constant velocity.
- E. The train is on level ground, moving in reverse and slowing down.

Tries 0/15

1 point(s)

Average From Graph

The velocity of an object moving in one-dimension along the x-axis is shown below as a function of time. The vertical scale is in m/s and the horizontal scale is in s . Over the complete time interval shown on the graph, determine the average velocity and average speed of the object.



- A. $v_{x,avg} = -0.2m/s$ and $v_{avg} = 1.4m/s$
- B. $v_{x,avg} = -2m/s$ and $v_{avg} = 14m/s$
- C. $v_{x,avg} = 2m/s$ and $v_{avg} = 14m/s$
- D. $v_{x,avg} = 2m/s$ and $v_{avg} = 2m/s$
- E. $v_{x,avg} = 0.2m/s$ and $v_{avg} = 1.4m/s$

Tries 0/15

1 point(s)

City Block Averages 2

A car is initially traveling east through New York City at 19 mph. As the car approaches an intersection it stops and turns left to go north. After traveling one block north the car stops and turns right to once again head east. At the final time the car is traveling east at 5 mph. Which direction best describes the average acceleration of the car as a result of the motion described above?

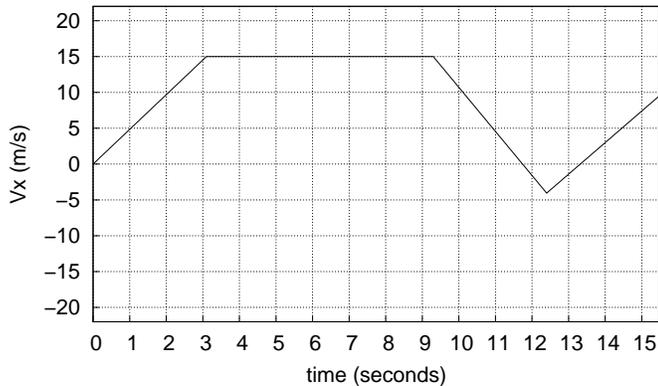
- A. Northeast.
- B. North.
- C. Northwest.
- D. West.
- E. East.

Tries 0/15

2 point(s)

Position, velocity, and acceleration: graphical relationships 1

A hummingbird, **starting from the origin**, flies along the x axis with the following velocity as a function of time.



Is there another time on the graph, other than at $t = 0$ s, when the hummingbird is at the origin?

- A. At a time near 11.7 s.
- B. At a time near 13.3 s.
- C. At times between 3.1 and 9.3 s.
- D. There is no other time when the hummingbird is at the origin.
- E. At times near 11.7 s and 13.3 s.

Tries 0/15

Is there a time on the graph when the hummingbird has zero acceleration?

- A. At a time near 11.7 s.
- B. At times near 11.7 s and 13.3 s.
- C. At times between 3.1 and 9.3 s.
- D. There is no time on the graph when the hummingbird has zero acceleration.
- E. At a time near 13.3 s.

Tries 0/15

1 point(s)

Finding acceleration from position

A spaceship is rocketing through space following the trajectory

$$x(t) = \frac{b_x}{t + t_1} \quad ; \quad y(t) = b_y(t + t_1)^2$$

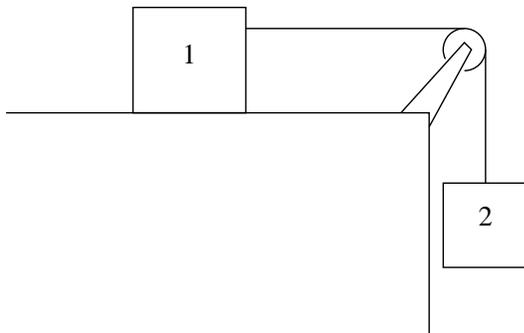
where $b_x = 460000$ m·s, $b_y = 190$ m/s², and $t_1 = 4.4$ s. What is the magnitude of the acceleration of the rocket at $t = 3.1$ seconds?

Tries 0/15

1 point(s)

Atwood at 90 without Friction

Block 1 with mass 66 kg is sitting on a horizontal frictionless surface as shown below. It is attached to a string of negligible mass that goes over a pulley with negligible mass and negligible friction. The other end of the string is attached to block 2 with mass 254 kg. Find the magnitude of the common acceleration of the two blocks!



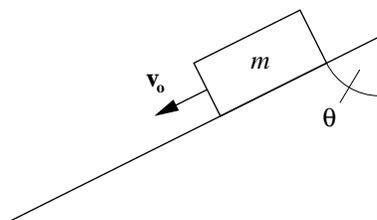
- A. $a = 37.75 \text{ m/s}^2$
- B. $a = 13.25 \text{ m/s}^2$
- C. $a = 5.76 \text{ m/s}^2$
- D. $a = 0 \text{ m/s}^2$
- E. $a = 7.79 \text{ m/s}^2$

Tries 0/15

1 point(s)

Box on ramp with friction

A box of mass 7.7 kg is given an initial speed of $v_o = 5.1 \text{ m/s}$ along a ramp as indicated in the figure ($\theta = 69.7^\circ$).



If the coefficient of kinetic friction between the box and the ramp is $\mu_k = 0.48$, find the magnitude of the acceleration of the box.

Tries 0/15

6 point(s)

Action hero fired from a cannon with conceptual questions

Note: for this problem, you can neglect air resistance.

An action hero is trying to use a circus cannon to get to the roof on a building 42.9 meters away. She launches herself with an initial velocity of 27.4 m/s at an angle 59.4 degrees above the horizontal, but instead of landing on the roof she hits the wall of the building.

How high up on the wall does she hit?

Tries 0/15

She tries again, this time launching at a speed of 63.0 m/s. She goes over the building entirely and lands on the ground on the other side.

How much time does she spend in the air?

Tries 0/15

What is the height of the action hero at the peak of her trajectory?

Tries 0/15

How far from her launch point will she land?

Tries 0/15

Call the horizontal distance traveled by the action hero to the peak of her trajectory: d , her height at the peak: h , and the **total** distance she travels to the peak of her trajectory (arclength): d_{tot} . How does d_{tot} compare to $\sqrt{d^2 + h^2}$?

- A. Cannot be determined.
- B. $d_{tot} > \sqrt{d^2 + h^2}$
- C. $d_{tot} = \sqrt{d^2 + h^2}$
- D. $d_{tot} < \sqrt{d^2 + h^2}$

Tries 0/15

In another situation, the action hero uses her jet-pack to give her an instantaneous, **horizontal** boost in velocity of magnitude v_b at the top of her trajectory in the direction of her motion. If her final speed immediately after the instantaneous boost is v_f and her initial horizontal velocity is v_{ox} , which of the following is true?

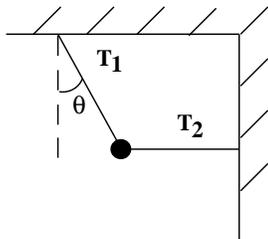
- A. $v_f < v_b + v_{ox}$
- B. Cannot be determined.
- C. $v_f = v_b + v_{ox}$
- D. $v_f > v_b + v_{ox}$

Tries 0/15

1 point(s)

String Tension

A steel ball of mass 4.3 kg is suspended from two strings as shown in the picture.



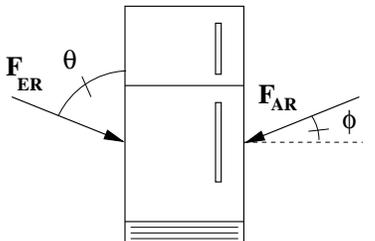
The upper string is at an angle of $\theta = 31.0^\circ$ from the vertical, while the lower string is horizontal. Calculate the magnitude of T_2 , the tension in the lower string.

Tries 0/15

1 point(s)

Static friction on a refrigerator with two applied forces

Ed and Al are pushing on a refrigerator as shown in the picture. They are **not** pushing hard enough to make the refrigerator move.



Ed is pushing with a force of 218.3 N at an angle of $\theta = 50.3$ degrees with respect to the vertical and Al is pushing with a force of 80.5 N at an angle of $\phi = 34.7$ degrees with respect to the horizontal. If the refrigerator has a mass of 147 kg and the coefficients of static and kinetic friction between the floor and refrigerator are $\mu_s = 0.55$ and $\mu_k = 0.41$, what is the magnitude of the force of friction exerted by the floor on the refrigerator?

Tries 0/15

1 point(s)

Multi-step rocket problem

You are designing a weather rocket that is to be launched from rest, vertically upward off the ground. The engine burn will last for 2.8 s. If the positive y direction is upward, away from the ground, then the acceleration during the engine burn (including the influence of gravity) is

$$a_y(t) = bt^3$$

with $b = 12.23 \text{ m/s}^5$ and t the time from engine ignition. After the engine burns out, the acceleration is then

$$a_y(t) = -g$$

How long after the engine burns out does the rocket take to reach its maximum height?

Tries 0/15

1 point(s)

Tension From Position for Elevator

At time $t = 0$ s, a motor begins to move a small elevator of mass 123 kg by unreeling a cable. The position of the elevator as a function of time is given by

$$y(t) = y_0 e^{-t/t_1}$$

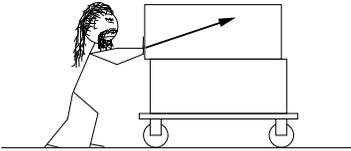
where $y_0 = 53$ m and $t_1 = 1.44$ s and we have defined up to be the positive y direction. What is the tension in the elevator cable at time $t = 2.12$ s?

Tries 0/15

1 point(s)

Q7

The Great Kelso is pushing two large boxes on a cart as shown. The mass of the top box is 65 kg and the mass of the bottom box (plus the cart) is 114 kg. He pushes up slightly so that his force makes an angle of 20 degrees with the horizontal, and the magnitude of his force is 224 N. Assuming that the wheels are good enough that you can neglect friction between the ground and the cart, what is the magnitude of the static friction force between the two boxes? The coefficient of static friction between the boxes is 0.53.



- A. 134.1 N
- B. 224.0 N
- C. 210.5 N
- D. 297.3 N
- E. 338.0 N

Tries 0/15

PHGN100 Exam 1 Free Response

Name: KEY CWID: _____ Exam Code _____



do not write in the box above

Circle Studio Time: 8-10 10-12 12-2 2-4

Note: Your responses will be graded for accuracy and presentation. Please circle your final answer

1.(7 pts) A box of mass m_b is being blown by a strong steady wind across the level surface of a picnic table. The wind exerts a constant horizontal force of magnitude F_{wb} . As the block slides it accelerates with a magnitude a_b . Assuming that kinetic friction is acting, develop an expression for the coefficient of kinetic friction μ_k between the box and table. Your final answer should be in terms of m_b , F_{wb} , a_b and g .

system = block

$$\sum \vec{F}_{i,b} = m_b \vec{a}_b$$

$$f_{k,table} = \mu_k N_{table}$$

$$x: F_{wb} - f_{k,table} = m_b a_{b,x} = m_b a_b$$

$$y: N_{table} - m_b g = m_b a_{b,y} = 0 \Rightarrow N_{table} = m_b g$$

$$F_{wb} - \mu_k m_b g = m_b a_b \Rightarrow \mu_k = \frac{1}{m_b g} [F_{wb} - m_b a_b]$$

2.(6 pts) At a certain time while sliding the box is moving with a speed v_1 . At a later time it is sliding with a speed v_2 . Develop an expression for the distance d the box slides during this time interval in terms of v_1 , v_2 and a_b .

Using x
 may be assumed from part 1.

$$v_x(t) = v_x(0) + \int_0^t a_x(t) dt$$

$$v_x(t) = v_1 + \int_0^t a_b dt$$

$$v_x(t) = v_1 + a_b t$$

$$v_x(t_2) = v_2 = v_1 + a_b t_2$$

$$t_2 = \frac{v_2 - v_1}{a_b}$$

$$x(t) = x(0) + \int_0^t v_x(t) dt$$

$$x(t) = x(0) + \int_0^t (v_1 + a_b t) dt$$

$$x(t) = x(0) + v_1 t + \frac{1}{2} a_b t^2$$

$$d = x(t_2) - x(0) = v_1 \frac{(v_2 - v_1)}{a_b} + \frac{1}{2} a_b \left(\frac{v_2 - v_1}{a_b} \right)^2$$

3.(7 pts) The box eventually slides off the edge of the table. When it leaves the table it is moving with a speed v_3 . Develop an expression for the speed of the box at a time t after it slides off the table and before it hits the ground in terms of v_3 , F_{wb} , m_b , t and g . You should assume that the wind is still blowing.

system = block

$$\sum \vec{F}_{i,b} = m_b \vec{a}_b$$

$$x: F_{wb} = m_b a_{b,x} \Rightarrow a_{b,x} = \frac{F_{wb}}{m_b}$$

$$y: -m_b g = m_b a_{b,y} \Rightarrow a_{b,y} = -g$$

$$v_x(t) = v_x(0) + \int_0^t a_{b,x}(t) dt$$

$$v_x(t) = v_3 + \int_0^t \frac{F_{wb}}{m_b} dt$$

$$v_x(t) = v_3 + \frac{F_{wb}}{m_b} t$$

$$v_y(t) = v_y(0) + \int_0^t a_{b,y}(t) dt$$

$$v_y(t) = 0 + \int_0^t -g dt$$

$$v_y(t) = -gt$$

$$V(t) = \sqrt{v_x^2(t) + v_y^2(t)} = \sqrt{\left(v_3 + \frac{F_{wb}}{m_b} t \right)^2 + (-gt)^2}$$