# Practice Midterm 2 [ Edit ]

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## Practice Midterm 2

**Due: 7:00pm on Monday, March 19, 2018**

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

## Problem 4.35

**Description:** Basketball player Darrell Griffith is on record as attaining a standing vertical jump of 1.2 m (4 ft). (This means that he moved upward by 1.2 m after his feet left the floor.) Griffith weighed 890 N (200 lb). (a) What is his speed as he leaves the...

Basketball player Darrell Griffith is on record as attaining a standing vertical jump of 1.2 $\mathrm{m}$ (4 $\mathrm{ft}$). (This means that he moved upward by 1.2 $\mathrm{m}$ after his feet left the floor.) Griffith weighed 890 $\mathrm{N}$ (200 $\mathrm{lb}$).

### Part A

What is his speed as he leaves the floor?

**Express your answer using two significant figures.**

ANSWER:

$v$ = 4.9 $\mathrm{m/s}$

### Part B

If the time of the part of the jump before his feet left the floor was 0.300 $\mathrm{s}$, what was the magnitude of his average acceleration while he was pushing against the floor?

**Express your answer using two significant figures.**

ANSWER:

$a$ = 16 $\mathrm{m/s^2}$

### Part C

What is its direction?

ANSWER:

- (selected) upward
- downward

### Part D

Use Newton's laws and the results of part (B) to calculate the average force he applied to the ground.

**Express your answer using two significant figures.**

ANSWER:

$F$ = $2.4\times10^{3}$ N

Also accepted: $2.3\times10^{3}$

## Exercise 5.28

**Description:** A box of bananas weighing 40.0 N rests on a horizontal surface. The coefficient of static friction between the box and the surface is 0.40 and the coefficient of kinetic friction is 0.20. (a) If no horizontal force is applied to the box and the...

A box of bananas weighing 40.0 $\mathrm{N}$ rests on a horizontal surface. The coefficient of static friction between the box and the surface is 0.40 and the coefficient of kinetic friction is 0.20.

### Part A

If no horizontal force is applied to the box and the box is at rest, how large is the friction force exerted on the box?

ANSWER:

0 N

### Part B

What is the magnitude of the friction force if a monkey applies a horizontal force of 6.0 $\mathrm{N}$ to the box and the box is initially at rest?

**Express your answer using two significant figures.**

ANSWER:

6.0 N

### Part C

What minimum horizontal force must the monkey apply to start the box in motion?

**Express your answer using two significant figures.**

ANSWER:

16 N

### Part D

What minimum horizontal force must the monkey apply to keep the box moving at constant velocity once it has been started?

**Express your answer using two significant figures.**

ANSWER:

8 $\mathrm{N}$

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**Part E**

If the monkey applies a horizontal force of 18.0 $\mathrm{N}$, what is the magnitude of the friction force ?

**Express your answer using two significant figures.**

ANSWER:

8 $\mathrm{N}$

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**Part F**

If the monkey applies a horizontal force of 18.0 $\mathrm{N}$, what is the box's acceleration?

ANSWER:

2.45 $\mathrm{m/s^2}$

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# Exercise 5.36

**Description:** A box of textbooks of mass m rests on a loading ramp that makes an angle alpha with the horizontal. The coefficient of kinetic friction is mu_k and the coefficient of static friction is mu_s. (a) As the angle alpha is increased, find the...

A box of textbooks of mass 25.8 $\mathrm{kg}$ rests on a loading ramp that makes an angle $\alpha$ with the horizontal. The coefficient of kinetic friction is 0.24 and the coefficient of static friction is 0.36.

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**Part A**

As the angle $\alpha$ is increased, find the minimum angle at which the box starts to slip.

**Express your answer using two significant figures.**

ANSWER:

$\mathrm{atan}\left(\mu_s\right)\frac{180}{\pi}$ = 20 $^\circ$

Also accepted: $\mathrm{atan}\left(\mu_s\right)\frac{180}{\pi}$ = 19.8, $\mathrm{atan}\left(\mu_s\right)\frac{180}{\pi}$ = 20

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**Part B**

At this angle, find the magnitude of the acceleration once the box has begun to move.

**Express your answer using two significant figures.**

ANSWER:

$9.80\left(\sin\left(\mathrm{atan}\left(\mu_s\right)\right)-\mu_k\cos\left(\mathrm{atan}\left(\mu_s\right)\right)\right)$ = 1.1 $\mathrm{m/s^2}$

Also accepted: $9.80\left(\sin\left(\mathrm{atan}\left(\mu_s\right)\right)-\mu_k\cos\left(\mathrm{atan}\left(\mu_s\right)\right)\right)$ = 1.11, $9.80\left(\sin\left(\mathrm{atan}\left(\mu_s\right)\right)-\mu_k\cos\left(\mathrm{atan}\left(\mu_s\right)\right)\right)$ = 1.1

## Part C

At this angle, how fast will the box be moving after it has slid a distance 5.0 $\mathrm{m}$ along the loading ramp?

**Express your answer using two significant figures.**

ANSWER:

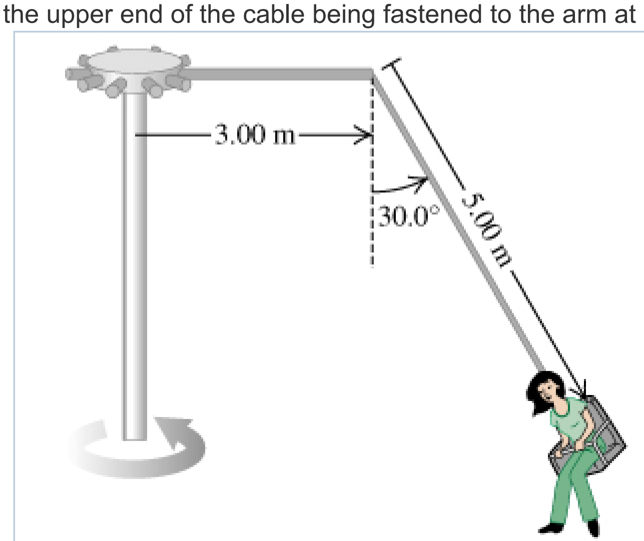
$\sqrt{2 \cdot 9.80\left(\sin\left(\mathrm{atan}\left(\mu_s\right)\right)-\mu_k\cos\left(\mathrm{atan}\left(\mu_s\right)\right)\right)x}$ = 3.3 $\mathrm{m/s}$

Also accepted: $\sqrt{2 \cdot 9.80\left(\sin\left(\mathrm{atan}\left(\mu_s\right)\right)-\mu_k\cos\left(\mathrm{atan}\left(\mu_s\right)\right)\right)x}$ = 3.33,
$\sqrt{2 \cdot 9.80\left(\sin\left(\mathrm{atan}\left(\mu_s\right)\right)-\mu_k\cos\left(\mathrm{atan}\left(\mu_s\right)\right)\right)x}$ = 3.3

# Exercise 5.50

**Description:** The "Giant Swing" at a county fair consists of a vertical central shaft with a number of horizontal arms attached at its upper end. Each arm supports a seat suspended from a cable 5.00 m long, the upper end of the cable being fastened to the arm at a...

The "Giant Swing" at a county fair consists of a vertical central shaft with a number of horizontal arms attached at its upper end. Each arm supports a seat suspended from a cable 5.00 $\mathrm{m}$ long, the upper end of the cable being fastened to the arm at a point 3.00 $\mathrm{m}$ from the central shaft.




## Part A

Find the time of one revolution of the swing if the cable supporting a seat makes an angle of $30.0^\circ$ with the vertical.

ANSWER:

$T$ = 6.19 $\mathrm{s}$

## Part B

Does the angle depend on the weight of the passenger for a given rate of revolution?

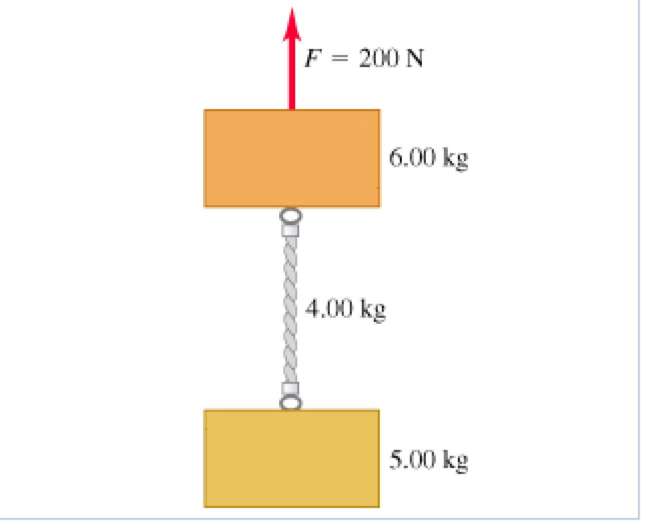
ANSWER:

- ○ Yes.
- ◉ No.

# Problem 4.48

**Description:** The two blocks in the figure are connected by a heavy uniform rope with a mass of 4.00 kg . An upward force of 200 N is applied as shown. (a) What is the acceleration of the system? (b) What is the tension at the top of the heavy rope? (c)...

The two blocks in the figure are connected by a heavy uniform rope with a mass of 4.00 $\mathrm{kg}$ . An upward force of 200 $\mathrm{N}$ is applied as shown.




## Part A

What is the acceleration of the system?

ANSWER:

$a$ = 3.53 $\mathrm{m/s^2}$

## Part B

What is the tension at the top of the heavy rope?

ANSWER:

$T$ = 120 $\mathrm{N}$

## Part C

What is the tension at the midpoint of the rope?

ANSWER:

$T$ = 93.3 $\mathrm{N}$

## Exercise 6.47

**Description:** A small glider is placed against a compressed spring at the bottom of an air track that slopes upward at an angle of alpha above the horizontal. The glider has mass m. The spring has k and negligible mass. When the spring is released, the glider...

A small glider is placed against a compressed spring at the bottom of an air track that slopes upward at an angle of 36.0 $^\circ$ above the horizontal. The glider has mass 8.00×10$^{-2}$ $\mathrm{kg}$ . The spring has 680 $\mathrm{N/m}$ and negligible mass. When the spring is released, the glider travels a maximum distance of 1.30 $\mathrm{m}$ along the air track before sliding back down. Before reaching this maximum distance, the glider loses contact with the spring.

### Part A

What distance was the spring originally compressed?

ANSWER:

$x$ = $\sqrt{\frac{2m\cdot 9.8l\sin(\alpha)}{k}}$ = 4.20×10$^{-2}$ $\mathrm{m}$

### Part B

When the glider has traveled along the air track 0.300 $\mathrm{m}$ from its initial position against the compressed spring, is it still in contact with the spring?

ANSWER:

- ○ Yes
- ◉ No

### Part C

What is the kinetic energy of the glider at this point?

ANSWER:

$K$ = $m\cdot 9.8(l-x)\sin(\alpha)$ = 0.461 $\mathrm{J}$

## Exercise 6.48

**Description:** An ingenious bricklayer builds a device for shooting bricks up to the top of the wall where he is working. He places a brick on a vertical compressed spring with force constant k = 450 N/m and negligible mass. When the spring is released, the...

An ingenious bricklayer builds a device for shooting bricks up to the top of the wall where he is working. He places a brick on a vertical compressed spring with force constant $k$ = 450 $\mathrm{N/m}$ and negligible mass. When the spring is released, the brick is propelled upward.

### Part A

If the brick has mass 1.80 $\mathrm{kg}$ and is to reach a maximum height of 3.6 $\mathrm{m}$ above its initial position on the compressed spring, what distance must the bricklayer compress the spring initially?

**Express your answer using two significant figures.**

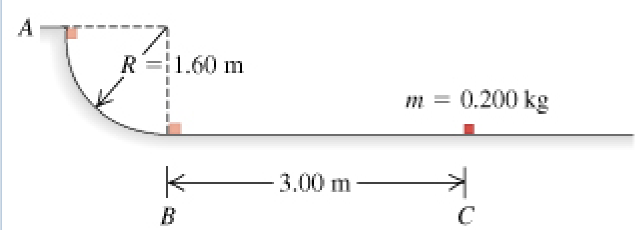
ANSWER:

$d$ = 0.53 $\mathrm{m}$

## Problem 7.57

**Description:** In a truck-loading station at a post office, a small 0.200-kg package is released from rest at point A on a track that is one-quarter of a circle with radius 1.60 m (the figure ). The size of the package is much less than 1.60 m, so the package can be ...

In a truck-loading station at a post office, a small 0.200-$\mathrm{kg}$ package is released from rest at point $A$ on a track that is one-quarter of a circle with radius 1.60 $\mathrm{m}$ (the figure ). The size of the package is much less than 1.60 $\mathrm{m}$, so the package can be treated as a particle. It slides down the track and reaches point $B$ with a speed of 4.60 $\mathrm{m/s}$ . From point $B$, it slides on a level surface a distance of 3.00 $\mathrm{m}$ to point $C$, where it comes to rest.




### Part A

What is the coefficient of kinetic friction on the horizontal surface?

ANSWER:

$\mu = \frac{\frac{1}{2}v^2}{9.8 \cdot 3}$ = 0.360

### Part B

How much work is done on the package by friction as it slides down the circular arc from $A$ to $B$?

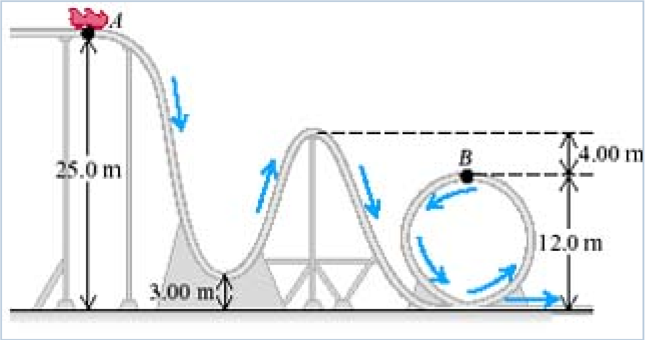
ANSWER:

$W$ = $\frac{.2v^2}{2} - .2 \cdot 9.8 \cdot 1.6$ = -1.02 J

## Problem 7.41

**Description:** A ## kg roller coaster starts from rest at point A and slides down the frictionless loop-the-loop shown in the accompanying figure. (a) How fast is this roller coaster moving at point B? (b) How hard does it press against the track at point B?

A 350 $\mathrm{kg}$ roller coaster starts from rest at point $A$ and slides down the frictionless loop-the-loop shown in the accompanying figure.




### Part A

How fast is this roller coaster moving at point $B$?

ANSWER:

$v$ = 16.0 $\mathrm{m/s}$

### Part B

How hard does it press against the track at point $B$?

ANSWER:

$F$ = $1.14 \times 10^4$ $\mathrm{N}$

## Exercise 5.58

**Description:** A bowling ball weighing w is attached to the ceiling by a rope of length L. The ball is pulled to one side and released; it then swings back and forth as a pendulum. As the rope swings through the vertical, the speed of the bowling ball is v. (a)...

A bowling ball weighing 70.6 $\mathrm{N}$ is attached to the ceiling by a rope of length 3.80 $\mathrm{m}$ . The ball is pulled to one side and released; it then swings back and forth as a pendulum. As the rope swings through the vertical, the speed of the bowling ball is 4.70 $\mathrm{m/s}$ .

## Part A

What is the acceleration of the bowling ball, in magnitude and direction, at this instant?

ANSWER:

$\frac{v^2}{L}$ = 5.81 $\mathrm{m/s^2}$

## Part B

What is the tension in the rope at this instant?

ANSWER:

$w\left(\frac{\frac{v^2}{L}}{g}+1\right)$ = 112 $\mathrm{N}$