Ch 7 Supplemental [Edit]

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Ch 7 Supplemental

Due: 6:59pm on Wednesday, October 26, 2016

To understand how points are awarded, read the Grading Policy for this assignment.

Exercise 7.24

Description: A m block on a horizontal floor is attached to a horizontal spring that is initially compressed x_1. The spring has force constant k. The coefficient of kinetic friction between the floor and the block is mu . The block and spring are released from ...

A 2.80 kg block on a horizontal floor is attached to a horizontal spring that is initially compressed 0.0400 m . The spring has force constant 845 $\mathrm{N/m}$. The coefficient of kinetic friction between the floor and the block is 0.38 . The block and spring are released from rest and the block slides along the floor.

Part A

What is the speed of the block when it has moved a distance of 0.0150 m from its initial position? (At this point the spring is compressed 0.0250 m .)

Express your answer with the appropriate units.

ANSWER:

$v = \sqrt{\frac{k\left(x_1{}^2 - x_3{}^2\right)}{m} - 2\mu \cdot 9.81 x_2}$ = 0.427 $\frac{\mathrm{m}}{\mathrm{s}}$

Exercise 7.33

Description: A small block with mass m is moving in the xy-plane. The net force on the block is described by the potential- energy function U(x,y)= (U_x)x^2-(U_y)y^3. (a) What is the magnitude of the acceleration of the block when it is at the point x= x , y= ...

A small block with mass 0.0400 kg is moving in the *xy*-plane. The net force on the block is described by the potential- energy function $U(x,y) =$ (5.95 $\mathrm{J/m^2}$)x^2-(3.50 $\mathrm{J/m^3}$)y^3.

Part A

What is the magnitude of the acceleration of the block when it is at the point $x =$ 0.39 m , $y =$ 0.69 m ?

Express your answer with the appropriate units.

ANSWER:

$a = \sqrt{\left(-\frac{2\left(U_x\right)x}{m}\right)^2 + \left(\frac{3\left(U_y\right)\left(y^2\right)}{m}\right)^2}$ = 171 $\frac{\mathrm{m}}{\mathrm{s^2}}$

Part B

What is the direction of the acceleration of the block when it is at the point $x = 0.39\ \mathrm{m}$, $y = 0.69\ \mathrm{m}$?

ANSWER:

$\theta = \dfrac{\left(\mathrm{atan}\left(-\frac{3(U_y)(y^2)}{2(U_x)x}\right)\right)\cdot 180}{\pi} + 180$ = 133 $^\circ$ counterclockwise from the $+x$-axis

Problem 7.43

Description: A m piece of wood slides on the surface shown in the figure . The curved sides are perfectly smooth, but the rough horizontal bottom is L long and has a kinetic friction coefficient of mu with the wood. The piece of wood starts from rest 4.0 m above...

A 2.5 kg piece of wood slides on the surface shown in the figure . The curved sides are perfectly smooth, but the rough horizontal bottom is 35 m long and has a kinetic friction coefficient of 0.27 with the wood. The piece of wood starts from rest 4.0 m above the rough bottom.

Part A

Where will this wood eventually come to rest?

Express your answer using two significant figures.

ANSWER:

$s = \dfrac{4}{\mu}$ = 15 m

Part B

For the motion from the initial release until the piece of wood comes to rest, what is the total amount of work done by friction?

ANSWER:

$W = -m\cdot 9.8\cdot 4$ = -98.0 J

Problem 7.56

Description: A ball is thrown upward with an initial velocity of ## m/s at an angle of ## degree(s) above the horizontal. (a) Use energy conservation to find the ball's greatest height above the ground.

A ball is thrown upward with an initial velocity of 12.0 $\mathrm{m/s}$ at an angle of 55.0 $^\circ$ above the horizontal.

Part A

Use energy conservation to find the ball's greatest height above the ground.

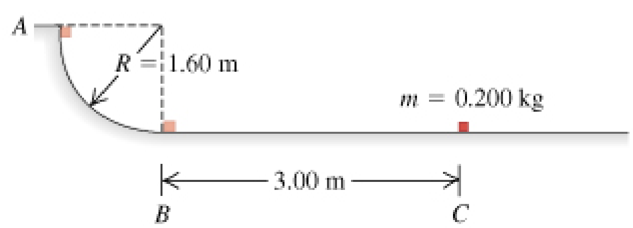
ANSWER:

h_{max} = $\frac{\frac{v^2\sin(\theta)\sin(\theta)}{2}}{g}$ = 4.93 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-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 treated as a particle. It slides down the track and reaches point B with a speed of 4.20 $\mathrm{m/s}$. From point B, it slides on a level surface a distance of 3.00 m to point C, where it comes to rest.



Part A

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

ANSWER:

μ = $\frac{\frac{1}{2}v^2}{9.8\cdot 3}$ = 0.300

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 = $\frac{.2v^2}{2} - .2\cdot 9.8\cdot 1.6$ = -1.37 J

Problem 7.80

Description: A proton with mass m moves in one dimension. The potential-energy function is U (x) = alpha /x^2 - beta /x, where alpha and beta are positive constants. The proton is released from rest at x_0 = alpha / beta. (a) Show that U (x) can be written as ...

A proton with mass m moves in one dimension. The potential-energy function is $U\left(x\right) = \alpha/x^2 - \beta/x$, where α and β are positive constants. The proton is released from rest at $x_0 = \alpha/\beta$.

Part A

Show that $U\left(x\right)$ can be written as

$$U\left(x\right) = \frac{\alpha}{x_0^2}\left[\left(\frac{x_0}{x}\right)^2 - \frac{x_0}{x}\right]$$

ANSWER:

3669 Character(s) remaining

Eliminating beta in favor of alpha and x_0 (beta = alpha/x_0).
U(x) = alpha/x^2 - beta/x = alpha/(x_0)^2((x_0/x)^2 - (x_0/x)).

Part B

Calculate $U\left(x_0\right)$.

Express your answer in terms of the variables α, x_0, m, and x.

ANSWER:

$U\left(x_0\right)$ = 0

Part C

Calculate $v\left(x\right)$, the speed of the proton as a function of position.

Express your answer in terms of the variables α, x_0, m, and x.

ANSWER:

$$v(x) = \sqrt{\frac{2\alpha}{m(x_0)^2}\left(\frac{x_0}{x} - \left(\frac{x_0}{x}\right)^2\right)}$$

Part D

For what value of x is the speed of the proton a maximum?

Express your answer in terms of the variables α, x_0, m, and x.

ANSWER:

$x = 2x_0$

Part E

What is the value of that maximum speed?

Express your answer in terms of the variables α, x_0, m, and x.

ANSWER:

$$v_{\max} = \sqrt{\frac{\alpha}{2m(x_0)^2}}$$

Part F

What is the force on the proton at the point in part D?

Express your answer in terms of the variables α, x_0, m, and x.

ANSWER:

$F = 0$

Part G

Let the proton be released instead at $x_1 = 3\alpha/\beta$. Calculate $v(x)$.

Express your answer in terms of the variables α, x_0, m, and x.

ANSWER:

$$v(x) = \sqrt{\frac{2\alpha}{m(x_0)^2}\left(\frac{x_0}{x} - \left(\frac{x_0}{x}\right)^2 - \frac{2}{9}\right)}$$

Part H

For the release point $x = x_0$, what are the maximum and minimum values of x reached during the motion?

ANSWER:

- ○ $\frac{5}{2}x_0$ and $\frac{1}{2}x_0$
- ○ $5x_0$ and $2x_0$
- ○ $3x_0$ and $\frac{3}{2}x_0$
- ◉ ∞ and x_0

Part I

For the release point $x = x_1$, what are the maximum and minimum values of x reached during the motion?

ANSWER:

- ○ $\frac{5}{2}x_0$ and $\frac{1}{2}x_0$
- ○ $5x_0$ and $2x_0$
- ◉ $3x_0$ and $\frac{3}{2}x_0$
- ○ ∞ and x_0