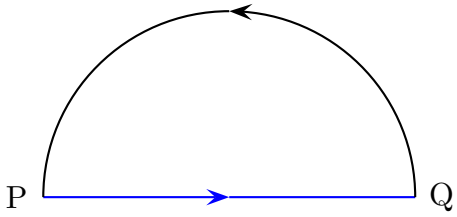
This print-out should have 15 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 10.0 points

On a horizontal surface, an object slides from point P to point Q along a straight line, then slides back from Q to P along a semicircle.



If P and Q are a distance L apart, how much work did the force of kinetic friction do during the entire process? The magnitude of $\mathbf{f}_k$ is f_k.

1. $2\,L\,f_k$

2. $-(\pi+1)\,L\,f_k$

3. $2\,\pi\,L\,f_k$

4. $(2\,\pi-1)\,L\,f_k$

5. Zero, since $\oint \mathbf{f}_k \cdot d\mathbf{r} = 0$

6. $-\left(\frac{\pi}{2}+1\right) L\,f_k$

7. $-(2\,\pi+1)\,L\,f_k$

8. $2\,(\pi+1)\,L\,f_k$

002 10.0 points

In a certain region of space, a particle experiences a potential energy $U(x) = \dfrac{A}{x^2} + B$, where A and B are constants.

What force $\mathbf{F}$ gives rise to this potential energy?

1. There is no force, since the slope of the line is the constant $\dfrac{B}{A}$.

2. $-\hat{\mathbf{i}}\left(\dfrac{A}{x} + B\,x\right)$

3. $-\hat{\mathbf{i}}\left(\dfrac{2\,A}{x^3}\right)$

4. $-\hat{\mathbf{i}}\left(\dfrac{A}{x}\right)$

5. $-\hat{\mathbf{i}}\left(\dfrac{A}{x^2}\right)$

6. $\hat{\mathbf{i}}\left(\dfrac{A}{x}\right)$

7. $\hat{\mathbf{i}}\left(\dfrac{A}{x} + B\,x\right)$

8. $\hat{\mathbf{i}}\left(\dfrac{A}{x^2}\right)$

9. $\hat{\mathbf{i}}\left(\dfrac{2\,A}{x^3}\right)$

003 10.0 points

A rubber band resists being stretched along x with a force $\vec{F}_b = -\hat{\imath}\,\beta\,\sqrt{x}$, where β is a constant.

What would be the potential energy function $U_b(x)$ for the rubber band in terms of β and x?

1. None of these

2. $U_b(x) = -2\,\beta\,x^{-1/2}$

3. $U_b(x) = -\dfrac{2\,\beta}{3}\,x^{3/2}$

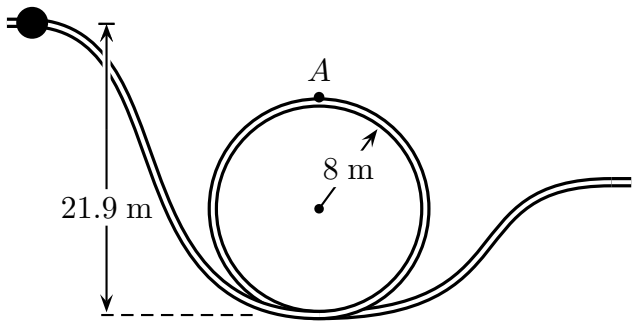
4. $U_b(x) = 2\,\beta\,x^{-1/2}$

5. $U_b(x) = \dfrac{2\,\beta}{3}\,x^{3/2}$

004 10.0 points

A bead slides without friction around a loop-the-loop. The bead is released from a height of 21.9 m from the bottom of the loop-the-loop which has a radius 8 m.

The acceleration of gravity is 9.8 m/s^2 .

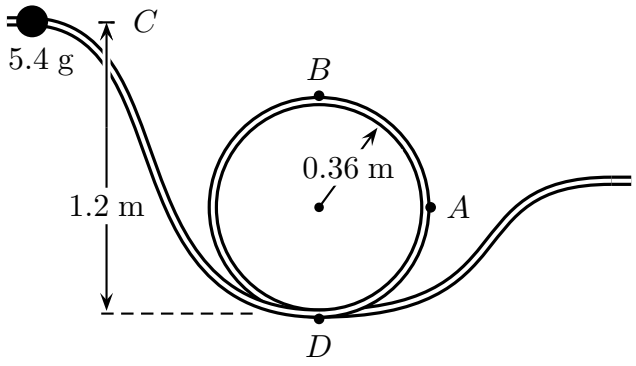


What is its speed at point A ?
Answer in units of m/s

005 (part 1 of 2) 10.0 points

A 5.4 g mass is released from rest at C which has a height of 1.2 m above the base of a loop-the-loop and a radius of 0.36 m .

The acceleration of gravity is 9.8 m/s^2 .



Find the normal force pressing on the track at A, where A is at the same level as the center of the loop.
Answer in units of N

006 (part 2 of 2) 10.0 points

Consider a different situation when the initial height at C has not yet been specified.

What is the minimum kinetic energy of the block at B, which is located at the top of the loop, so that the block can pass by this point without falling off from the track?
Answer in units of J

007 (part 1 of 2) 10.0 points

Betty weighs 417 N and she is sitting on a playground swing seat that hangs 0.38 m above the ground. Tom pulls the swing back and releases it when the seat is 0.88 m above the ground.

The acceleration of gravity is 9.8 m/s^2 .

How fast is Betty moving when the swing passes through its lowest position?
Answer in units of m/s

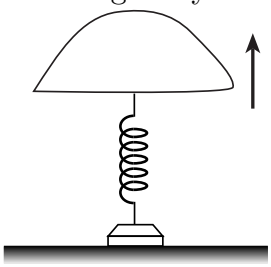
008 (part 2 of 2) 10.0 points

If Betty moves through the lowest point at 1.4 m/s, what is the magnitude of the work done on the swing by friction?
Answer in units of J

009 10.0 points

A child's toy consists of plastic attached to a spring. The spring is compressed against the floor a distance of 2.33 cm, and the toy is released.

The acceleration of gravity is 9.8 m/s^2 .

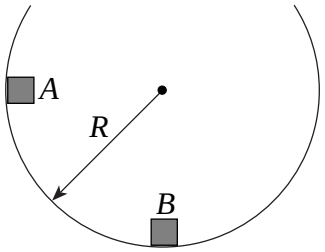


If the toy has a mass of 104 g and rises to a maximum height of 62.5 cm, estimate the force constant of the spring.
Answer in units of N/m

010 (part 1 of 2) 10.0 points

A 220 g particle in a semi-spherical bowl of radius 0.2 m is released from rest at point A at the level of the center of the bowl, and the surface of the bowl is rough. The speed of the particle at B is 1.4 m/s.

The acceleration of gravity is 9.8 m/s^2 .



What is its kinetic energy at B?
Answer in units of J

011 (part 2 of 2) 10.0 points

What is the magnitude of the energy lost due

to friction as the particle moves from A to B?

Answer in units of J

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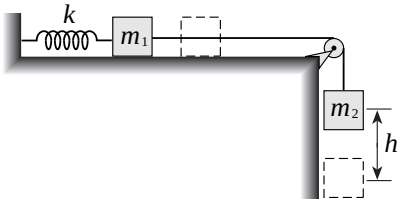
012 10.0 points

Two blocks are connected by a light string that passes over a frictionless pulley as in the figure. The block of mass 8.05 kg lies on a horizontal surface and is connected to a spring of force constant 291 N/m. The system is released from rest when the spring is unstretched.



If the hanging 14.4 kg block falls a distance 0.742 m before coming to rest, calculate the coefficient of kinetic friction between the block m_1 and the surface. The acceleration of gravity is 9.8 m/s^2 .

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013 10.0 points

A potential energy function for a two-dimensional force is of the form

$$\mathcal{U} = a\,x^3\,y + b\,x\,,$$

where $a = 6.07$ J/m^4 and $b = -7$ J/m.

Find the magnitude of the force that acts at the point (x, y) for $x = 95$ m, $y = 14$ m.

Answer in units of N

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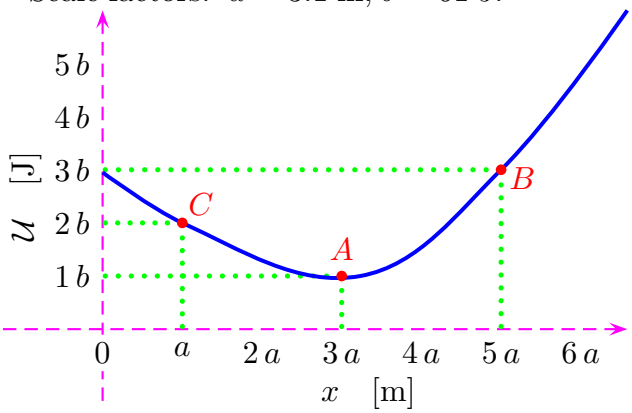
014 (part 1 of 2) 10.0 points

A particle moving along the x-axis has a potential energy $U(x)$, as shown in the accompanying graph.

Scale factors: $a = 3.1$ m, $b = 61$ J.



What is the force exerted on the particle when $x = 3\,a$ (point A, the lowest point on the curve)?

Answer in units of N

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015 (part 2 of 2) 10.0 points

If the particle has a mass of 8 kg and is released from rest at $x = 5\,a$, what is the particle's velocity when it reaches $x = a$?

Answer in units of m/s