WebAssign
CH09-HW02-SP12 (Homework)

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PHYS 172-SPRING 2012, Spring 2012
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Current Score : 39 / 39 **Due :** Thursday, March 22 2012 11:59 PM EDT

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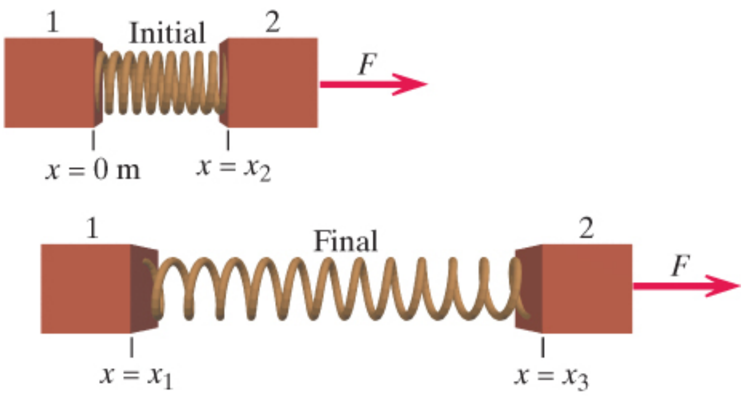
1. 21/21 points | Previous Answers MI3 9.5.P.043

Moving blocks connected by a spring

Two identical 0.11 kg blocks (labeled 1 and 2) are initially at rest on a nearly frictionless surface, connected by an unstretched spring, as shown in the upper diagram, where x_2 = 0.05 m. Then a constant force of 12 N to the right is applied to block 2, and at a later time the blocks are in the new positions shown in the lower diagram, where x_1 = 0.02 m and x_3 = 0.12 m. At this final time, the system is moving to the right and also vibrating, and the spring is stretched.



MOTION OF THE CENTER OF MASS OF THE REAL SYSTEM

What is the initial location of the center of mass of the real system?

$x_{CM,initial}$ = 0.025 m

What is the final location of the center of mass of the real system?

$x_{CM,final}$ = 0.07 m

How far did the center of mass of the real system move?

Δx_{CM} = 0.045 m

POINT PARTICLE SYSTEM

What is the initial location of the point particle system?

$x_{initial}$ = 0.025 m

What is the final location of the point particle system?

x_{final} = 0.07 m

How far did the point particle system move?

Δx = 0.045 m

In the point particle system, what was the distance through which the point of application of the force moved?

distance = 0.045 m

How much work was done on the point particle system?

W = 0.54 joules

Check all the forms of energy that change in the point particle system during this process:

- [ ] vibrational kinetic energy
- [x] translational kinetic energy
- [ ] rotational kinetic energy
- [ ] thermal energy
- [ ] spring potential energy

✓

What was the change in the translational kinetic energy of the point particle system?

ΔK_{trans} = 0.54 ✓ joules

What is the final translational kinetic energy of the point particle system?

K_{trans} = 0.54 ✓ joules

What is the mass of the point particle system?

m = 0.22 ✓ kg

What is the final speed of the point particle system?

$v_{cm,final}$ = 2.2156 ✓ m/s

REAL SYSTEM

The force was applied to a location on the right hand edge of block 2. Look carefully at the diagrams. In the real system, what was the distance through which the point of application of the force moved?

distance = 0.07 ✓ m

How much work was done on the real system?

W = 0.84 ✓ joules

Check all the forms of energy that change in the real system during this process (assume that the vibrating spring doesn't get hot):

- [ ] rotational kinetic energy
- [x] spring potential energy
- [x] vibrational kinetic energy
- [x] translational kinetic energy

✓

What is the change in energy of the real system?

$\Delta(K_{tot} + U)$ = 0.84 ✓ joules

What is $(K_{tot} + U)_{final}$ for the real system?

$(K_{tot} + U)_{final}$ = 0.84 joules

What is the final translational kinetic energy of the real system?

$K_{trans,final}$ = 0.54 joules

What is the final speed of the center of mass of the real system?

$v_{cm,final}$ = 2.2156 m/s

What is the final vibrational energy of the real system (spring potential energy plus kinetic energy relative to the center of mass)?

$(U + K_{rel})_{final}$ = 0.3 joules

- *Read the eBook*
- Section 9.5

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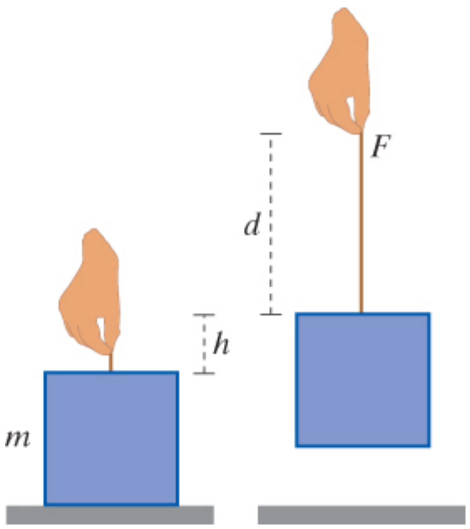
2. 15/15 points | Previous Answers MI3 9.5.P.045



A box contains machinery that can rotate. The total mass of the box plus the machinery is 7 kg. A string wound around the machinery comes out through a small hole in the top of the box. Initially the box sits on the ground, and the machinery inside is not rotating (left diagram). Then you pull upwards on the string with a force of constant magnitude 124 N. At an instant when you have pulled 0.61 m of string out of the box (indicated as *d* on the diagram), the box has risen a distance of 0.23 m (indicated as *h* on the diagram), and the machinery inside is rotating.

POINT PARTICLE SYSTEM

Check all the forms of energy that change for the point particle system during this process:

- [ ] rotational kinetic energy
- [x] translational kinetic energy
- [ ] spring potential energy
- [ ] gravitational potential energy

What is the y component of the displacement of the point particle system during this process?

Δy = 0.23 m

What is the y component of the net force acting on the point particle system during this process?

$F_{net,y}$ = 55.4 N

What is the distance through which the net force acts on the point particle system?

0.23 m

How much work is done on the point particle system during this process?

W = 12.742 J

What is the speed of the box at the instant shown in the right diagram?

v = 1.908 m/s

Why is it not possible to find the rotational kinetic energy of the machinery inside the box by considering only the point-particle system?

- (•) A point particle doesn't have rotational kinetic energy
- ( ) The mass of the machinery is not given
- ( ) The energy principle does not apply to rotating objects

REAL SYSTEM

The real system consists of the box, the machinery inside the box, and the string. Check all the forms of energy that change for the real system during this process:

- [x] rotational kinetic energy
- [ ] spring potential energy
- [ ] gravitational potential energy
- [x] translational kinetic energy

What is the translational kinetic energy of the real system, at the instant shown in the right diagram?

K_{trans} = 12.742 J

What is the distance through which the gravitational force acts on the real system?

0.23 m

How much work is done on the system by the gravitational force?

W_{grav} = -15.778 J

What is the distance through which your hand moves? 0.84 m

How much work do you do on the real system?

W_{hand} = 102.48 J

At the instant shown in the right diagram, what is the total kinetic energy of the real system?

K_{total} = 86.702 J

What is the rotational kinetic energy of the machinery inside the box?

$K_{rot,f}$ = 75.64 J

- *Read the eBook*
- Section 9.5

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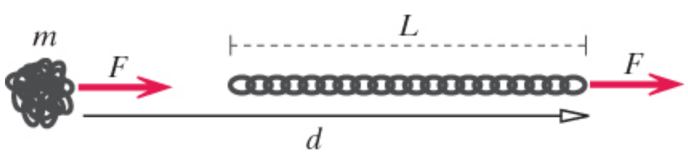
3. 3/3 points | Previous Answers MI3 9.5.P.034

A chain of metal links with total mass m = 6 kg is coiled up in a tight ball on a low-friction table. You pull on a link at one end of the chain with a constant force F = 62 N. Eventually the chain straightens out to its full length L = 1.2 m, and you keep pulling until you have pulled your end of the chain a total distance d = 3.8 m (diagram is not to scale).



(a) Consider the point particle system:

What is the speed of the chain at this instant?

v = 8.132 m/s>

(b) Consider the real system:

What is the change in energy of the chain?

ΔE = 235.6 joules

(c) In straightening out, the links of the chain bang against each other, and their temperature rises. Assume that the process is so fast that there is insufficient time for significant thermal transfer of energy from the chain to the table, and ignore the small amount of energy radiated away as sound produced in the collisions among the links. Calculate the increase in thermal energy of the chain.

$\Delta E_{thermal}$ = 37.212 J

- *Read the eBook*
- Section 9.5