ConcepTest 14.0

The reading quiz was …

(in terms of the ease of use,

***not* in terms of physics)**

A) straightforward to use

B) easy enough to use (no major problems)

C) kind of difficult to use (some major problems)

D) pain in the …

ConcepTest 14.0

I feel that I learned some physics from the reading quiz.

A) yes, most definitely

B) don't know … but it surely made me think hard

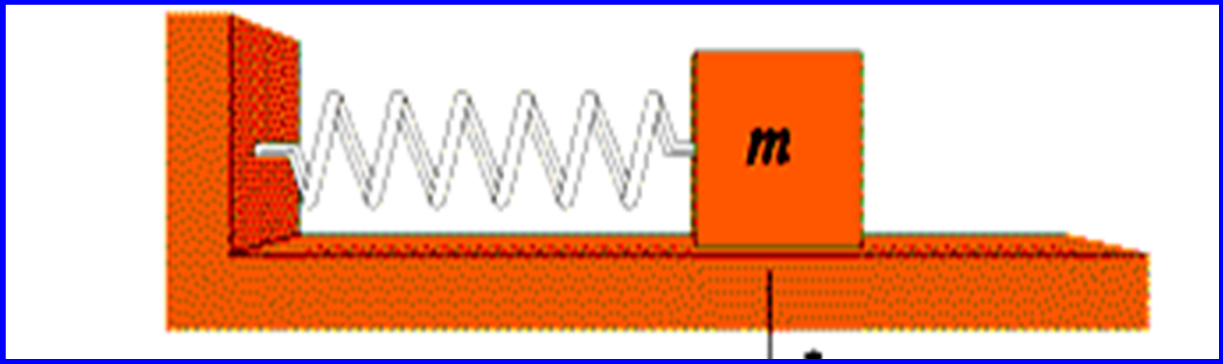
C) it made me totally confused, overall …

D) not at all

ConcepTest 14.1a Harmonic Motion I

A mass on a spring in SHM has amplitude *A* and period *T*. What is the total distance traveled by the mass after a time interval *T*?

a) 0
b) *A*/2
c) *A*
d) 2*A*
ab) 4*A*



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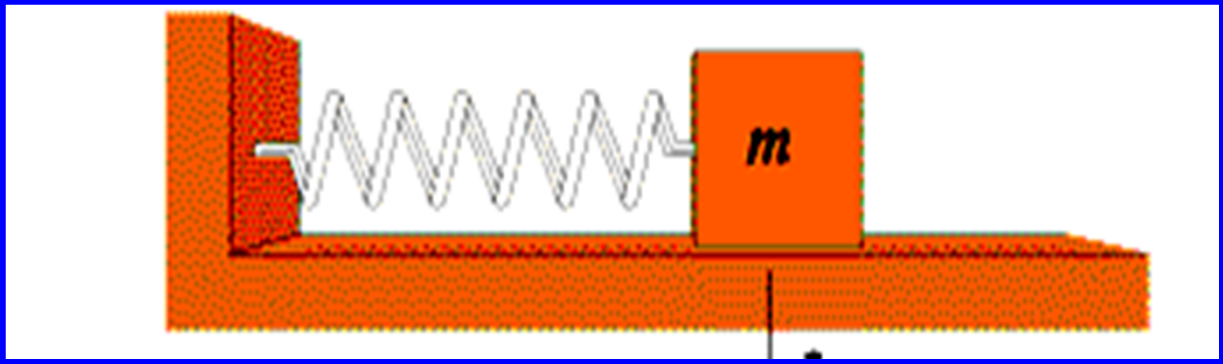


In the time interval *T* (the period), the mass goes through one complete oscillation back to the starting point. The distance it covers is *A* + *A* + *A* + *A* (4*A*).

ConcepTest 14.1b Harmonic Motion II

A mass on a spring in SHM has amplitude *A* and period *T*. What is the net displacement of the mass after a time interval *T*?

a) 0
b) *A*/2
c) *A*
d) 2*A*
ab) 4*A*

ConcepTest 14.1b Harmonic Motion II

A mass on a spring in SHM has amplitude *A* and period *T*. What is the net displacement of the mass after a time interval *T*?

a) 0
b) *A*/2
c) *A*
d) 2*A*
ab) 4*A*

The displacement is $\Delta x = x_2 - x_1$. Because the initial and final positions of the mass are the same (it ends up back at its original position), then the displacement is zero.

Follow-up: What is the net displacement after a half of a period?

ConcepTest 14.2 Speed and Acceleration

A mass on a spring in SHM has amplitude A and period T. At what point in the motion is $v = 0$ and $a = 0$ simultaneously?

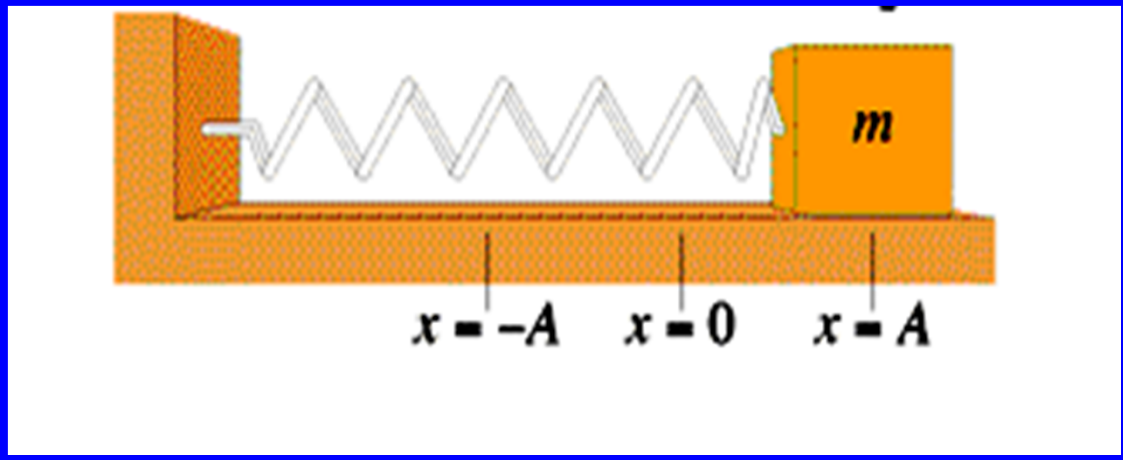
a) $x = A$

b) $x > 0$ but $x < A$

c) $x = 0$

d) $x < 0$

ab) none of the above



ConcepTest 14.2 Speed and Acceleration

A mass on a spring in SHM has amplitude A and period T. At what point in the motion is $v = 0$ and $a = 0$ simultaneously?

a) $x = A$

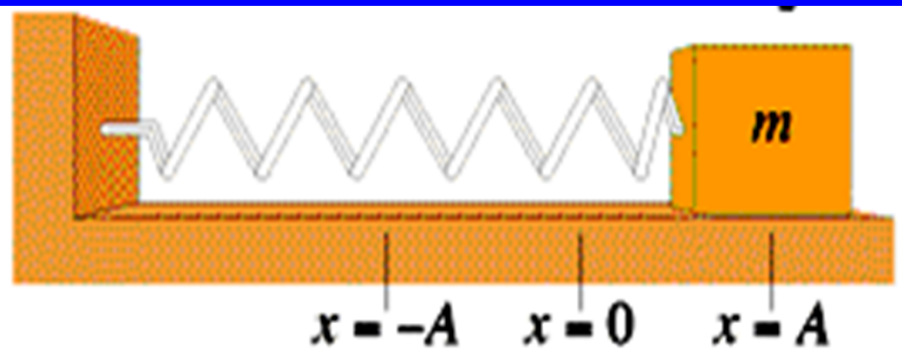
b) $x > 0$ but $x < A$

c) $x = 0$

d) $x < 0$

ab) none of the above

If both v and a were zero at the same time, the mass would be at rest and stay at rest! Thus, there is *NO point* at which both v and a are both zero at the same time.



Follow-up: Where is acceleration a maximum?

ConcepTest 14.3a Spring Combination I

A spring can be stretched a distance of 60 cm with an applied force of 1 *N*. If an identical spring is connected in parallel with the first spring, and both are pulled together, how much force will be required to stretch this parallel combination a distance of 60 cm?

a) $\frac{1}{4}$ *N*
b) $\frac{1}{2}$ *N*
c) 1 *N*
d) 2 *N*
ab) 4 *N*

ConcepTest 14.3a Spring Combination I

A spring can be stretched a distance of 60 cm with an applied force of 1 *N*. If an identical spring is connected in parallel with the first spring, and both are pulled together, how much force will be required to stretch this parallel combination a distance of 60 cm?

a) $\frac{1}{4}$ *N*
b) $\frac{1}{2}$ *N*
c) 1 *N*
d) 2 *N*
ab) 4 *N*

Each spring is still stretched 60 cm, so each spring requires 1 *N* of force. But because there are two springs, there must be a total of 2 *N* of force! Thus, the combination of two parallel springs behaves like a stronger spring!!

ConcepTest 14.3b Spring Combination II

A spring can be stretched a distance of 60 cm with an applied force of 1 *N*. If an identical spring is connected in series with the first spring, how much force will be required to stretch this series combination a distance of 60 cm?

a) $\frac{1}{4}$ ***N***

b) $\frac{1}{2}$ ***N***

c) **1 *N***

d) **2 *N***

ab) **4 *N***

ConcepTest 14.3b Spring Combination II

A spring can be stretched a distance of 60 cm with an applied force of 1 *N*. If an identical spring is connected in series with the first spring, how much force will be required to stretch this series combination a distance of 60 cm?

a) $\frac{1}{4}$ ***N***

b) $\frac{1}{2}$ ***N***

c) 1 *N*

d) 2 *N*

ab) 4 *N*

Here, the springs are in series, so each spring is only stretched 30 cm, and only half the force is needed. But also, because the springs are in a row, the force applied to one spring is transmitted to the other spring (like tension in a rope). So the overall applied force of $\frac{1}{2}$ *N* is all that is needed. The combination of two springs in series behaves like a weaker spring!!

ConcepTest 14.7a Spring in an Elevator I

A mass is suspended from the ceiling of an elevator by a spring. When the elevator is at rest, the period is *T*. What happens to the period when the elevator is moving upward at constant speed?

a) period will increase
b) period will not change
c) period will decrease

ConcepTest 14.7a Spring in an Elevator I

A mass is suspended from the ceiling of an elevator by a spring. When the elevator is at rest, the period is *T*. What happens to the period when the elevator is moving upward at constant speed?

a) period will increase
b) period will not change
c) period will decrease

Nothing at all changes when the elevator moves at constant speed. The equilibrium elongation of the spring is the same, and the period of simple harmonic motion is the same.

ConcepTest 14.7b Spring in an Elevator II

A mass is suspended from the ceiling of an elevator by a spring. When the elevator is at rest, the period is *T*. What happens to the period when the elevator is accelerating upward?

a) period will increase
b) period will not change
c) period will decrease

ConcepTest 14.7b Spring in an Elevator II

A mass is suspended from the ceiling of an elevator by a spring. When the elevator is at rest, the period is *T*. What happens to the period when the elevator is accelerating upward?

a) period will increase

b) period will not change

c) period will decrease

When the elevator accelerates upward, the hanging mass feels "heavier" and the spring will stretch a bit more. Thus, the equilibrium elongation of the spring will increase. However, the period of simple harmonic motion does not depend upon the elongation of the spring—it only depends on the mass and the spring constant, and neither one of them has changed.

ConcepTest 14.7c Spring on the Moon

A mass oscillates on a vertical spring with period *T*. If the whole setup is taken to the Moon, how does the period change?

a) period will increase
b) period will not change
c) period will decrease

ConcepTest 14.7c Spring on the Moon

A mass oscillates on a vertical spring with period *T*. If the whole setup is taken to the Moon, how does the period change?

a) period will increase
b) period will not change
c) period will decrease

The period of simple harmonic motion depends only on the mass and the spring constant and does not depend on the acceleration due to gravity. By going to the Moon, the value of *g* has been reduced, but that does not affect the period of the oscillating mass–spring system.

Follow-up: Will the period be the same on any planet?