

Spring Scales

Question

A diver stands motionless at the end of a spring board, which bends downward. If her identical twin joins her, how far downward will the board then bend?

- A. The same amount.
- B. Twice as far.
- C. Four times as far.

What is a spring scale measuring?

An oscillating spring scale can measure mass.

Mass is independent of measuring location.

Mass is measured by acceleration.

A spring scale in equilibrium can measure weight.

Weight is the gravitational force acting on an object.

Weight is proportional to mass.

Weight depends on measuring location.

How can a spring scale measure weight?

Equilibrium

An object in equilibrium experiences zero net force.

The individual forces balance.

An object in equilibrium is not accelerating.

An object at rest remains at rest.

An object in motion coasts.

To measure weight using equilibrium

Balance the object's weight with a support force.

Measure the support force.

Springs

A free spring has an equilibrium length.

Its ends experience zero net force.
Its ends are not accelerating.

When stretched the spring pulls its end back toward its equilibrium position.

When compressed the spring pushes its end back toward its equilibrium position.

The strength of the pull or push is proportional to how much it is stretched.

Hooke's Law

The restoring force on the end of a spring is equal to a spring constant times the distance the spring is distorted. That force is directed opposite the distortion.

restoring force = $-$ spring constant \cdot distortion

To measure weight using a spring scale

Support the object's weight with a spring.
Allow the object to settle at equilibrium.
Measure how much the spring is stretched.

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Two Spring Scales

Using two springs support the object's weight.

The sum of the scale reading will equal the object's weight.

Will the two scale readings be the same?

Only if the center of gravity is midway between the two scales.

Center of gravity: the effective location of an objects weight.

Usually coincides with the object's center of mass.

Equilibrium

An object in equilibrium experiences zero net force.

The individual forces balance.

The object does not accelerate.

The object's translational velocity does not change.

An object in equilibrium experiences zero net torque.

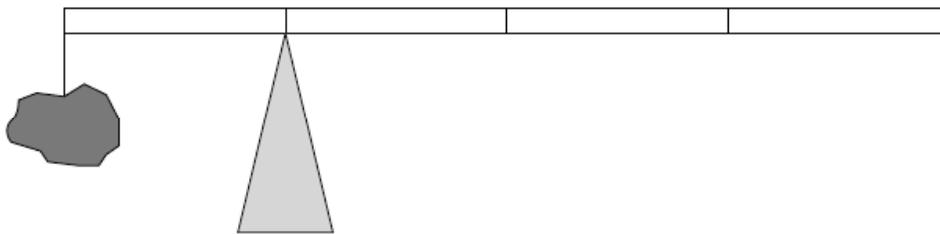
The individual torques balance.

The object does not experience an angular acceleration.

The object's angular velocity remains constant.

Question

A 1-kg rock is suspended by a massless string from one end of a 1-m measuring stick. What is the weight of the measuring stick if it is balanced by a support force at the 0.25-m mark?



1. 0.25 kg
2. 0.5 kg
3. 1 kg
4. 2 kg
5. 4 kg

Elastic Potential Energy

Stretching a spring requires work.

Stretching a spring transfers energy to the spring.

The spring stores this energy as elastic potential energy.

When released this elastic potential energy is converted into kinetic energy.

This kinetic energy is then converted back into elastic potential energy.

The spring's energy oscillates.

When the spring is released the restoring force accelerates its end toward the equilibrium position.

When the end arrives at its equilibrium it experiences no acceleration, but it is moving – it overshoots and begins to slow.

The spring's position oscillate