OCR (A) Physics A-level

PAG 10.3 - Comparison of Methods of Determining Spring Stiffness

Practical Flashcards

What equation can be used to determine a spring constant using a static method?

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Force = Spring Constant x Extension

$$F = kx$$

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$$T = 2\pi\sqrt{\frac{m}{k}}$$

How will the time period of a mass-spring oscillator change if the spring constant is quadrupled?

How will the time period of a mass-spring oscillator change if the spring constant is quartered?

The time period of a mass-spring oscillator is inversely proportional to the the square root of the spring constant. This means that the time period will double.

How can the force applied to a spring by a hanging mass be calculated?

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Force = Mass x Gravitational Field Strength

$$F = mg$$

How can the spring constant be determined from a graph of force against extension?

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The spring constant is given by the gradient of a force-extension graph.

What should the graph of force against extension for a spring look like?

What should the graph of force against extension for a spring look like?

The force and extension of the spring should be directly proportional, assuming the limit of proportionality hasn't been exceeded. This means that the graph should form a straight line with a constant positive gradient, that passes through the origin.

How will your results be affected if the loads applied exceed the limit of proportionality?

How will your results be affected if the loads applied exceed the limit of proportionality?

Hooke's law only applies up to the limit of proportionality, so beyond this point the gradient of the line will no longer be constant and the spring constant cannot be determined.

Describe how the time period of a simple mass-spring oscillator varies with the length of the spring.

Describe how the time period of a simple mass-spring oscillator varies with the length of the spring.

The time period of a mass-spring oscillator does not depend on the length of the spring. It only depends on the mass and the spring constant.

What should your graph of T^2 against mass for a mass-spring oscillator look like?

What should your graph of T^2 against mass for a mass-spring oscillator look like?

The square of the time period and the mass attached to the spring should be directly proportional to each other. This means that the graph should show a straight line that passes through the origin.

How could the spring constant be calculated from a graph of T^2 against m for a simple mass-spring oscillator?

How could the spring constant be calculated from a graph of T^2 against m for a simple mass-spring oscillator?

$$T^2 = \frac{4\pi^2 m}{k}$$

‘k’ is therefore given by $4\pi^2$/gradient

How can the time period of a mass-spring oscillator be measured?

How can the time period of a mass-spring oscillator be measured?

The time it takes for 10 full oscillations can be recorded using a stop-clock. This can then be divided by 10 to give the time period for a single oscillation.

What can be added to your apparatus to make measuring the time period easier?

What can be added to your apparatus to make measuring the time period easier?

A fiducial marker can be added at the equilibrium position. This will make it easier to see when the system has completed a full oscillation.

Why may your measured value for the time period not be equal to the true value?

Why may your measured value for the time period not be equal to the true value?

Human reaction time will cause your stop-clock reading to differ slightly from the true value. There may also be an uncertainty determining exactly when a full oscillation has been completed.

How could the uncertainty due to human-reaction time be eliminated?

How could the uncertainty due to human-reaction time be eliminated?

An electronic timing system could be used instead of a manual stop-clock. This may be in the form of a light-gate or a motion sensor.

What unit is used for spring constants?

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N/kg

Suggest an advantage of using the static method of determining a spring constant over the dynamic method.

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The static method is likely to lead to more accurate measurements since there are less uncertainties due to factors such as motion and human reaction times. You can also take your time when taking readings, and a lab partner can confirm them.

What safety precautions should be taken when applying a load to a spring?

What safety precautions should be taken when applying a load to a spring?

Always wear safety goggles in case the spring snaps. The applied load should not exceed the maximum capacity of the spring. If the spring begins to deform plastically, do not add further load.

What safety precaution should be taken when hanging a load from a clamp stand?

What safety precaution should be taken when hanging a load from a clamp stand?

A counterweight or G-clamp should attached to the base of the clamp stand to provide a counter moment and prevent the stand from toppling.