Physics. You work it out.

Essential Pre-Uni Physics F7.1

A Level

Part A Angular frequency

A mass on a spring oscillates 5 times in $4.2\,\text{s}$. Calculate the angular frequency to 2 significant figures.

Part B Spring constant

Calculate the spring constant if the mass is $300\,\text{g}$. Give your answer to 2 significant figures.

Essential Pre-Uni Physics F7.2

A Level

You must give the correct units.

Calculate the maximum speed of an oscillator if its amplitude is $3.0\,\text{cm}$ and its time period is $0.65\,\text{s}$.

Gameboard:

STEM SMART Physics 35 - Oscillations

Essential Pre-Uni Physics F7.3

A Level

Calculate the maximum acceleration of an oscillator if its maximum speed is $1.2\,\mathrm{m\,s^{-1}}$ and its amplitude is $6.0\,\mathrm{cm}$.

Gameboard:

STEM SMART Physics 35 - Oscillations

Essential Pre-Uni Physics F7.4

A Level

A mass of $2.0\,\mathrm{kg}$ is suspended from a spring with constant $24\,\mathrm{N\,m^{-1}}$. Calculate the time period of the oscillation.

Gameboard:

STEM SMART Physics 35 - Oscillations

Physics. You work it out.

Essential Pre-Uni Physics F7.6

A Level

You must give the correct unit for each answer.

Part A Maximum speed

A man jumps off a bridge attached to a bungee. The time period of the oscillation is $4.7\,\mathrm{s}$, and its amplitude is $6.2\,\mathrm{m}$. Calculate the maximum speed of the man as he goes up and down.

Part B Maximum resultant force

The man has a mass of $85\,\mathrm{kg}$. Calculate the maximum resultant force acting on him during the motion.

Part C Spring constant

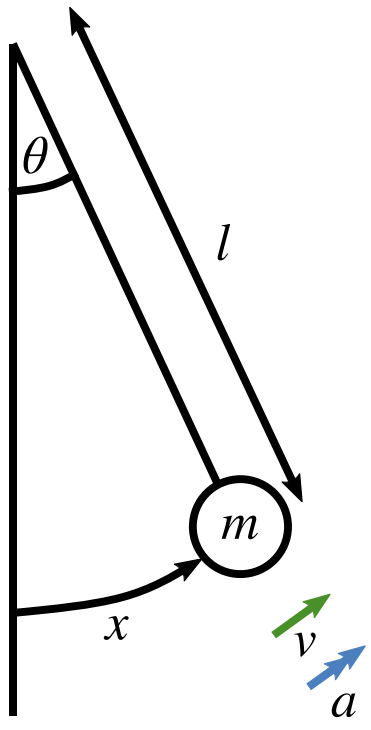
Calculate the 'spring constant' of the bungee rope using the information given.

Gameboard:

STEM SMART Physics 35 - Oscillations

Simple Pendulum 20.1

A Level



A simple pendulum.

Use the pendulum diagram provided to

Part A x in terms of l and θ

Write down an expression for the arc length (distance) x of the mass m from the vertical in terms of l and θ in radians.

The following symbols may be useful: `cos(), l, sin(), tan(), theta, x`

Part B Distance travelled

Calculate the distance the bob travels if it moves through an angle of 60° and the pendulum string has a length of $30\,\mathrm{cm}$.

Part C Resultant force

Write down the **magnitude** of the resultant force that acts perpendicular to the string on mass m.

The following symbols may be useful: `cos(), g, l, m, sin(), tan(), theta, x`

Part D Linear acceleration

Use your result from part C with Newton's Second Law derive an expression for the linear acceleration, a of the bob in terms of g and θ, taking care with the direction of the resultant force perpendicular to the string and the direction of positive acceleration shown on the diagram.

The following symbols may be useful: `a, cos(), g, sin(), tan(), theta`

Part E Simplify!

Use the small angle approximation for $\sin\theta$ to simplify your expression for a found in part D.

The following symbols may be useful: `a, g, theta`

Part F Linear acceleration in terms of g, l, x

By combining your result from part E with your answer for question A rewrite the linear acceleration a in terms of g, l and x.

The following symbols may be useful: `a, g, l, x`

Part G $\omega^2 = g/l$

Finally compare your answer from part F with the Simple Harmonic Motion equation for acceleration in terms of displacement, $a = -\omega^2 x$ to show that $\omega^2 = g/l$.

Gameboard:

STEM SMART Physics 35 - Oscillations

Simple Pendulum 20.3

A Level

A simple pendulum is made of a light string of length $l = 25\,\text{cm}$ with a bob of mass $m = 30\,\text{g}$ and is stationed on the Moon ($g_\text{m} = 1.63\,\text{m}\,\text{s}^{-1}$).

Part A Time period

What is the time period t_p for this pendulum?

Part B Oscillations in $1\,\text{min}$

How many whole oscillations does the pendulum make in $1\,\text{min}$?

Part C Angular frequency

Calculate the angular frequency of this pendulum using l and g and show that it is numerically equal to $2\pi f$.

Part D Doubling mass

What would the value of t_p and ω be if we doubled the mass of the bob to $2m$?

What is the value of t_p?

What is the value of ω?

Gameboard:

STEM SMART Physics 35 - Oscillations

Simple Pendulum 20.4

A Level

In a lecture demonstration three pendulums are set in motion. The first has a length l, the second has a length $4l$ and the third has a length $9l$.

If they all begin at the same amplitude and at the same time, how many whole swings will the first pendulum have completed after the initial drop when all three pendulums are instantaneously back in sync?

Gameboard:

STEM SMART Physics 35 - Oscillations

Essential Pre-Uni Physics F7.7

A Level

C C C

You must give the correct units.

Dr Nasty hates laundry. He designs $40\,\mathrm{kg}$ washing machines which resonate when they spin the clothes. His machine spins at $1200\,\mathrm{rpm}$, and when it resonates, it lurches about in the kitchen, putting holes in the cupboards and making a lot of noise. Calculate the 'spring constant' he designs the machines to have in order to achieve his horrible plan. Give your answer to 2 significant figures.

Gameboard:

STEM SMART Physics 35 - Oscillations

Physics. You work it out.

Essential Pre-Uni Physics F7.5

A Level

P P P

The height of the water on a beach can be approximated as simple harmonic motion with a period of $12\,\text{hours}$. If the mean water height is $3.5\,\text{m}$, the amplitude of the tide is $1.6\,\text{m}$, and `high water' occurs at 7am one day, what would you predict the height of the water to be at 11am?