Physics. You work it out.

A Level

P P P

Gravitational and Kinetic Energy 6

Linking Concepts in Pre-Uni Physics 1.6

At what speed will a $4.2\,\mathrm{kg}$ lump of clay hit a potter's wheel if it is thrown downwards at $1.1\,\mathrm{m\,s^{-1}}$ from a height $40\,\mathrm{cm}$ above the wheel?

The Lift

GCSE C C C A Level P P P

Part A Descending Lift: Tension

A lift, of mass m, is travelling downwards at a speed u. It is brought to rest by a constant acceleration over a distance h.

What is the tension, T, in the lift cable when the lift is stopping?

The following symbols may be useful: `T, g, h, m, u`

Part B Descending Lift: Work Done

What is the work done by the tension whilst stopping the lift?

The following symbols may be useful: `g, h, m, u`

Part C Ascending Lift: Tension

A lift, of mass m, is travelling upwards at a speed u. It is brought to rest by a constant acceleration over a distance h.

What is the tension, T, in the lift cable when the lift is stopping?

The following symbols may be useful: `T, g, h, m, u`

Part D Ascending Lift: Work Done

What is the work done by the tension whilst stopping the lift?

The following symbols may be useful: `g, h, m, u`

Gameboard:

STEM SMART Double Maths 38 - Energy & Elasticity

Work, Energy and Power 8

GCSE C C C A Level P P P

Essential Pre-Uni Physics B8.8

Physical constants which may be necessary to answer this problem can be found within the hint tab.

A $55\,\mathrm{kW}$ motor is used to lift a $4800\,\mathrm{kg}$ mass vertically up a mine shaft. What is the maximum possible speed that the mass could move upwards? Give your answer to 2 significant figures.

Gameboard:

STEM SMART Double Maths 38 - Energy & Elasticity

Physics. You work it out.

Home Gameboard Physics Mechanics Dynamics The Skiers

The Skiers

GCSE C C C A Level C C C

Two skiers want to reach the top of an incline without pushing. The first skier, of mass m, reaches the start of the incline with a speed v. He just makes it to the top of the incline. The second skier, of mass $\frac{2}{3}m$, has a speed $\frac{2}{3}v$ at the bottom of the incline. The incline has a vertical height h.

Will she make it to the top without pushing? It can be assumed that frictional forces are negligible.

- No, she makes it to $\frac{4}{9}h$
- Yes, she makes it to the top with a non-zero velocity
- Yes, she just makes it to the top
- No, she makes it to $\frac{8}{27}h$
- No, she makes it to $\frac{8}{9}h$

Adapted with permission from UCLES, A Level Physics, June 1987, Paper 1, Question 5.

Gameboard:
STEM SMART Double Maths 38 - Energy & Elasticity

Pedal Power

A Level

C C C

A $75\,\mathrm{kg}$ cyclist on a $15\,\mathrm{kg}$ bicycle pedals against a backwards resistive force that is proportional to the square of their speed. On a flat road, they can travel at a steady speed of $10.0\,\mathrm{m\,s^{-1}}$. While cycling up an incline, they produce the same power, but their steady speed is only $5.0\,\mathrm{m\,s^{-1}}$.

Part A Coasting down

At what speed could the cyclist coast down the incline, if they do not pedal?

Part B Head down

The cyclist knows that, regardless of their speed, they can reduce the resistive force by 20% by putting their head down. This allows them to travel at a higher steady speed.

By how much does their speed increase, if they put their head down:

(i) while coasting down the incline?

(ii) while pedalling on a flat road?

Part C Angle of the incline

When the cyclist puts their head down while cycling on a flat road at a steady speed, their initial acceleration is $0.050\,\mathrm{m\,s^{-2}}$.

What is the angle of the incline from earlier in the question?

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Home Gameboard Physics Mechanics Statics Springs 4

Springs 4

GCSE C C C A Level P P P

Essential Pre-Uni Physics B7.4

What mass should be suspended from a spring of length $20\,\mathrm{cm}$ and spring constant $6.0\,\mathrm{kN\,m^{-1}}$ in order for the spring to be stretched to a length of $22\,\mathrm{cm}$?

Gameboard:

STEM SMART Double Maths 38 - Energy & Elasticity

A Spring and a Thread

GCSE C C C A Level C C C

A light spring has a mass, m, suspended from its lower end. A second mass, n is suspended from the first by a thread. The arrangement is allowed to come into static equilibrium and then the thread is burned through.

At this instant, what is the upward acceleration of the mass m?

The following symbols may be useful: `a, g, m, n`

Used with permission from UCLES, A Level Physics, November 1987, Paper 1, Question 5.

Gameboard:
STEM SMART Double Maths 38 - Energy & Elasticity

Spring Triangle

A Level
C C C

A rod AB of length $d = 2.00\,\mathrm{m}$ is fixed horizontally. Two light identical springs of spring constant $k = 14.0\,\mathrm{N\,m^{-1}}$ are attached to the rod, one at each end. The loose ends of the springs are attached to each other at a point C and in this framework the springs are just taut. It is found that the angle made by one of the springs to the vertical $\alpha = 45.0\,^\circ$. A metal ball is then suspended from the springs at C and the angle made by one of the springs to the vertical is found to be $\beta = 30.0\,^\circ$.

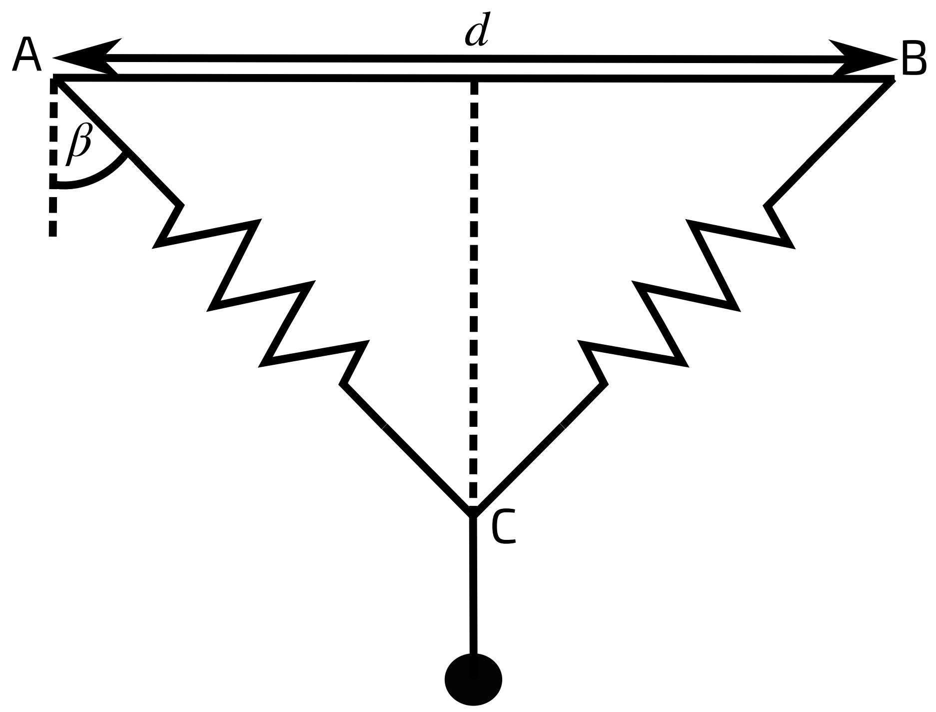

Figure 1: A metal ball suspended from two strings.

Taking the acceleration due to gravity as $g = 9.81\,\mathrm{m\,s^{-2}}$, what is the mass m of the ball?

- $0.725\,\mathrm{kg}$
- $1.45\,\mathrm{kg}$
- $0.837\,\mathrm{kg}$
- $4.94\,\mathrm{kg}$
- $1.67\,\mathrm{kg}$

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Energy, Springs and Materials 3

GCSE C C C A Level C C C

Essential Pre-Uni Physics B9.3

Assume that extension is proportional to the tension.

A spring with natural length $75\,\mathrm{cm}$ requires a force of $300\,\mathrm{N}$ in order for it to stretch to $85\,\mathrm{cm}$. How much EPE would be stored in the spring if it were stretched to $90\,\mathrm{cm}$? Give your answer to 2 significant figures.

Gameboard:
STEM SMART Double Maths 38 - Energy & Elasticity

Energy and Elastic Strings

Further A
P P P

A light elastic string, of natural length $50.0\,\mathrm{cm}$ and modulus of elasticity $15.0\,\mathrm{N}$, has one end attached to a fixed point A. A particle of mass $2.00\,\mathrm{kg}$ is attached to the other end of the string. The particle is projected vertically downwards from A with a velocity of $3.00\,\mathrm{m\,s^{-1}}$.

Part A Distance below A

Find the distance of the particle below A when it first comes to rest.

Part B Modulus of elasticity

The first string is removed and replaced with a different light elastic string of natural length $85.0\,\mathrm{cm}$ and modulus of elasticity λ. One end is again attached to A and the other end is attached to a particle of mass $2.00\,\mathrm{kg}$. When the particle is projected vertically downwards from A with a velocity of $3.00\,\mathrm{m\,s^{-1}}$, it first comes to rest $3.35\,\mathrm{m}$ below A.

Find the modulus of elasticity of the new string.

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