Gravitational Potential and Kinetic Energy 1.6

A Level

P P P

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`

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Essential Pre-Uni Physics B8.8

GCSE C C C A Level P P P

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.

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The Skiers

GCSE A Level

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

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

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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?

Essential Pre-Uni Physics B7.4

GCSE C C C A Level P P P

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 $22\,\mathrm{cm}$?

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A Spring and a Thread

GCSE A Level

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.

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Physics. You work it out.

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 $\alpha = 45.0\,°$. 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 $\beta = 30.0\,°$.

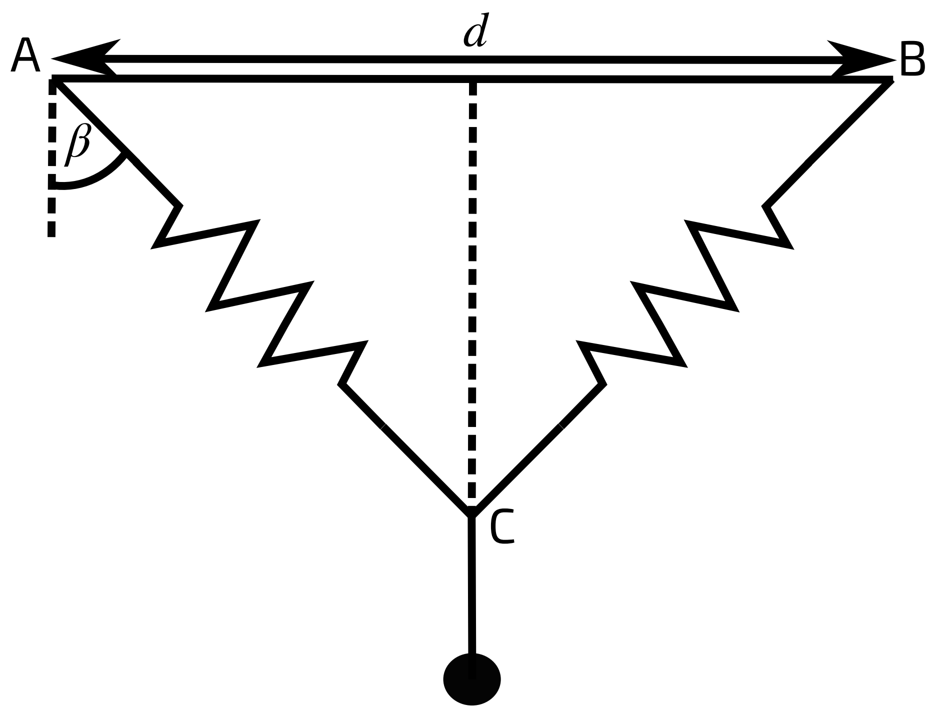

Figure 1: A metal ball suspended from two strings.

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

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

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Essential Pre-Uni Physics B9.3

GCSE A Level

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.

Pop-up Toy

A Level

A pop-up toy consists of a head and sucker of combined mass m stuck to the top of a light spring of natural length l_0 and spring constant k. The spring is compressed to length l_1 when the pop-up is stuck to the ground.

To what height above the ground does the bottom of the unstretched spring jump to when it is smoothly released?

The following symbols may be useful: `g`, `k`, `l_0`, `l_1`, `m`