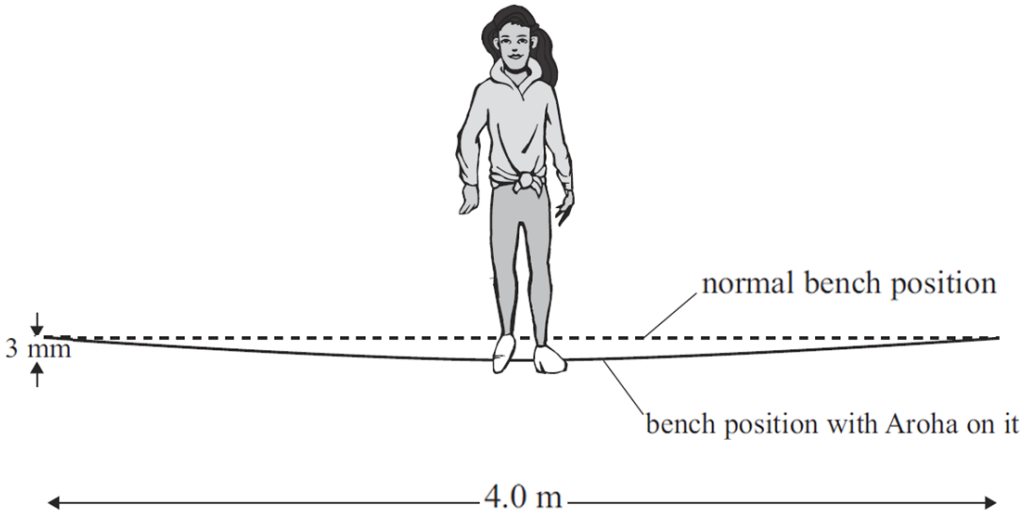
MECHANICS: HOOKES LAW QUESTIONS

THE SPECTATORS (2010;5)

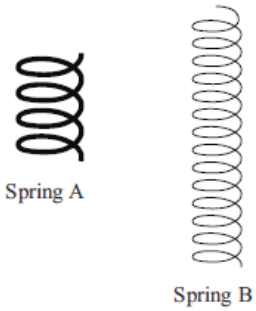
Aroha has a mass of 55 kg. She steps onto a bench to get a better view. The bench is 4.0 m long.



(a) When she gets on to the centre of the bench, it bends downwards 3.00 mm. Calculate the spring constant of the bench. Write your answer with the **correct SI unit.**
(b) Calculate the elastic potential energy stored in the bench

EQUILIBRIUM, MOMENTUM AND SPRINGS (2009;3)

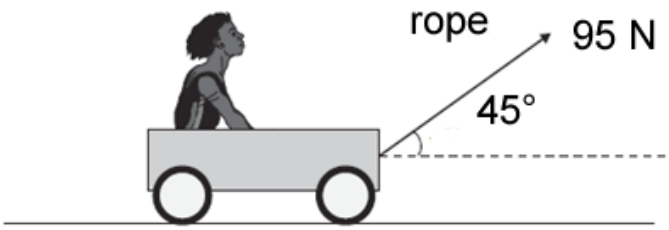
The springs (A) used in Harry's car seats are different from the spring (B) that Jill uses to hang a toy spider from the ceiling of her room. The diagram shows two types of spring.



Compressing spring A by 0.20 m requires 150 J of work. Stretching spring B by 0.30 m requires 210 J of work. By using appropriate working and reasoning, show by calculation which spring is stiffer.

GOING TO THE PLAYGROUND (2008;2)

Rua then climbs onto a trolley and Tahi tows him with a rope, as shown in the diagram below.



The rope stretches 1.0 cm with the 95 N tension force. Calculate the elastic potential energy stored in the stretched rope.

THE DUTY-FREE SHOP (2007;4)

At a duty-free shop at the airport, a toy teddy bear is hanging at the end of a spring. The spring is 51.0 cm long when hanging vertically.
When the teddy bear of mass 400 g is hung from the end of the spring, the length of spring becomes 72.0 cm.

(a) Calculate the spring constant. Write a unit with your answer.
(b) Calculate the energy stored in the spring when a second toy of mass 300 g is also hung along with the teddy bear on the spring.
(c) The 400 g teddy bear is now hung on a stiffer spring which has double the spring constant. Discuss how this affects the extension and the elastic energy stored in the spring.

TRAVELLING BY CAR (2006;1)

One of the reasons why cars have suspension systems is to help provide a smooth ride. Part of the suspension system consists of four springs, one at each corner of the car.

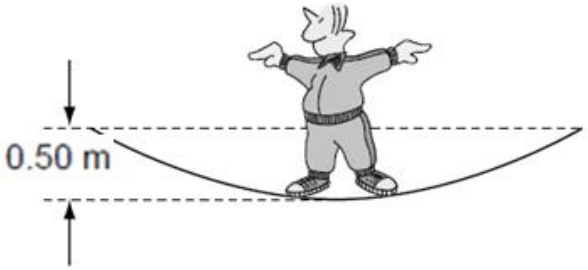
(i) The spring constant of each of the car's springs is 2.26×10^4 Nm^{-1}. Assuming that the weight of the occupants is evenly shared between the four springs, calculate how much the car sinks down when the driver and passengers (total mass 357 kg) all get into the car.
(ii) Calculate how much energy is stored in ONE front spring if it is compressed by 0.12 m.

SCHOOL GYM (2004;3)

Where needed, use g = 10.0 ms^{-2}.

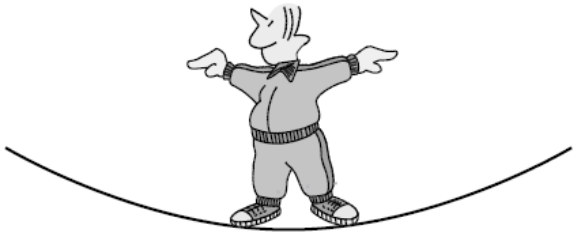
Henry is bouncing on the elastic mat of a trampoline.

In order to gain the necessary height to perform a certain move, Henry has stretched the mat downwards by 0.50 m. The spring constant of the mat is 3500 Nm^{-1}.



(i) Calculate the size of the force supplied by the mat when stretched by this amount.

(ii) On the diagram below, draw labelled arrow(s) to show the force(s) acting on Henry when he is at the lowest point of his bounce.



Henry has a mass of 75 kg.

(ii) Calculate the value of the net force acting on Henry when the trampoline mat is stretched downwards by 0.50 m.
(iii) State the direction of this net force.
(iv) Calculate Henry's initial acceleration when the mat is stretched downwards by 0.50 m.
(v) Calculate the vertical height to which Henry will rise above his lowest position.
(vi) Explain the physics involved in finding the answer to (vi), including a statement of any assumptions made.