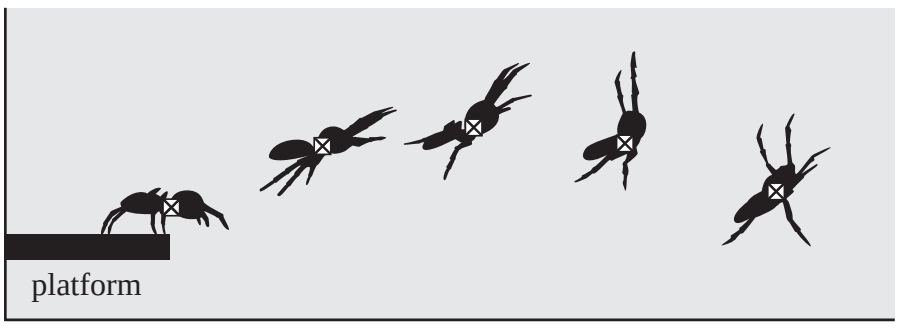
16 Scientists have been studying a type of jumping spider that can jump up to six times its body length.

(a) The scientists photographed a spider at 0.02s intervals, during a jump. The picture is taken from the photograph and is shown actual size.



(i) Deduce whether the images show that the motion in the *x*-direction is independent of the motion in the *y*-direction. You should take measurements using the cross marking the centre of gravity of the spider.

(4)

(ii) Show that the initial velocity of the spider at the start of the jump is about $1\,m\,s^{-1}$. You should take measurements using the cross marking the centre of gravity of the spider.

(5)

(iii) The spider achieves this jump by extending its two back legs by 3.0 mm.

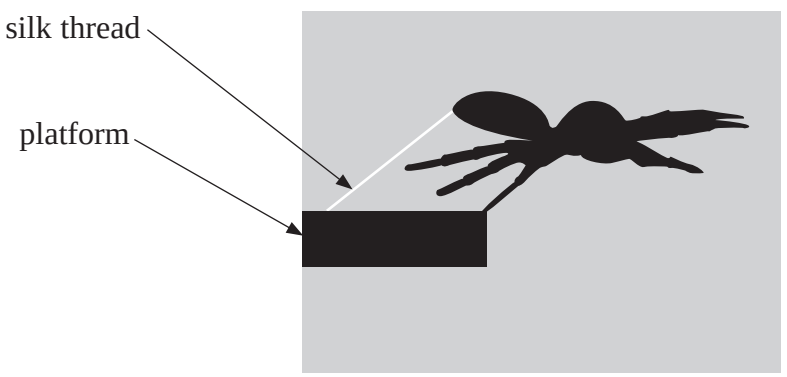
Calculate the average force the spider exerts in each leg to achieve the jump.

mass of spider = 150 mg

(3)

Average force = ...

(b) Just as the spider starts the jump, it fixes a silk thread to the platform. It is thought that the thread acts as a safety line in case the spider falls.



A student makes the comment:

'If the silk thread can withstand a tension equal to the weight of the spider then this safety system should work.'

Deduce whether this statement is correct.

(2)

(Total for Question 16 = 14 marks)