

- 4 (a) Explain what is meant by *strain energy* (*elastic potential energy*).

For  
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Use

.....

.....

..... [2]

- (b) A spring that obeys Hooke's law has a spring constant  $k$ .

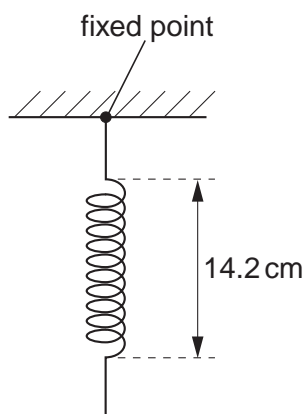
Show that the energy  $E$  stored in the spring when it has been extended elastically by an amount  $x$  is given by

$$E = \frac{1}{2}kx^2.$$

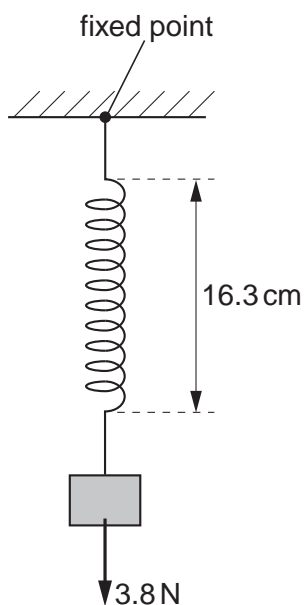
[3]

- (c) A light spring of unextended length 14.2 cm is suspended vertically from a fixed point, as illustrated in Fig. 4.1.

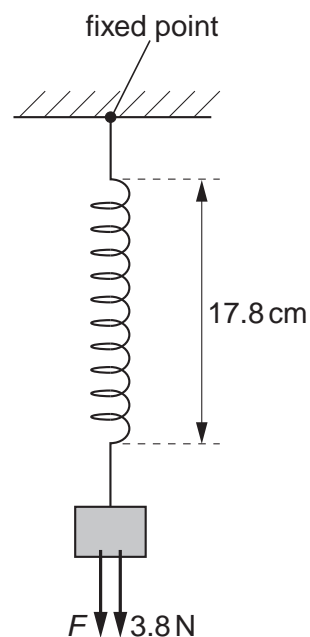
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**Fig. 4.1**



**Fig. 4.2**



**Fig. 4.3**

A mass of weight 3.8 N is hung from the end of the spring, as shown in Fig. 4.2. The length of the spring is now 16.3 cm.

An additional force  $F$  then extends the spring so that its length becomes 17.8 cm, as shown in Fig. 4.3.

The spring obeys Hooke's law and the elastic limit of the spring is not exceeded.

- (i) Show that the spring constant of the spring is  $1.8 \text{ N cm}^{-1}$ .

[1]

(ii) For the extension of the spring from a length of 16.3 cm to a length of 17.8 cm,

1. calculate the change in the gravitational potential energy of the mass on the spring,

change in energy = ..... J [2]

2. show that the change in elastic potential energy of the spring is 0.077 J,

[1]

3. determine the work done by the force  $F$ .

work done = ..... J [1]