

3 (a) State what is meant by

(i) *work done*,

.....  
 ..... [1]

(ii) *elastic potential energy*.

.....  
 ..... [1]

(b) A block of mass  $0.40\text{ kg}$  slides in a straight line with a constant speed of  $0.30\text{ m s}^{-1}$  along a horizontal surface, as shown in Fig. 3.1.



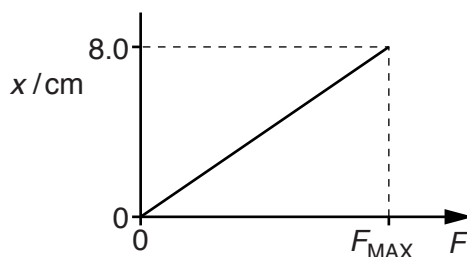
Fig. 3.1

The block hits a spring and decelerates. The speed of the block becomes zero when the spring is compressed by  $8.0\text{ cm}$ .

(i) Calculate the initial kinetic energy of the block.

kinetic energy = ..... J [2]

- (ii) The variation of the compression  $x$  of the spring with the force  $F$  applied to the spring is shown in Fig. 3.2.



**Fig. 3.2**

Use your answer in **(b)(i)** to determine the maximum force  $F_{\text{MAX}}$  exerted on the spring by the block.  
Explain your working.

$$F_{\text{MAX}} = \dots\dots\dots \text{N} \quad [3]$$

- (iii) Calculate the maximum deceleration of the block.

$$\text{deceleration} = \dots\dots\dots \text{ms}^{-2} \quad [1]$$

- (iv) State and explain whether the block is in equilibrium

1. before it hits the spring,

.....  
 .....

2. when its speed becomes zero.

.....  
 .....

[2]

(c) The energy  $E$  stored in a spring is given by

$$E = \frac{1}{2} k x^2$$

where  $k$  is the spring constant of the spring and  $x$  is its compression.

The mass  $m$  of the block in (b) is now varied. The initial speed of the block remains constant and the spring continues to obey Hooke's law.

On Fig. 3.3, sketch the variation of the maximum compression  $x_0$  of the spring with mass  $m$ .

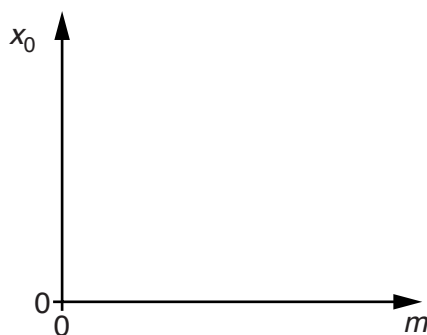


Fig. 3.3

[2]

[Total: 12]

