2 A 100 g mass is suspended on a spring of negligible mass. This causes the spring to extend and the mass to come to rest at its equilibrium position.

The force constant of the spring is 27 N m^{-1}.

(a) Show that the extension of the spring is approximately 4 cm.

[2]

(b) (i) The spring obeys Hooke's Law for extensions up to 10 cm.

On Fig. 2.1, sketch a force-extension graph for the spring up to an extension of 12 cm.

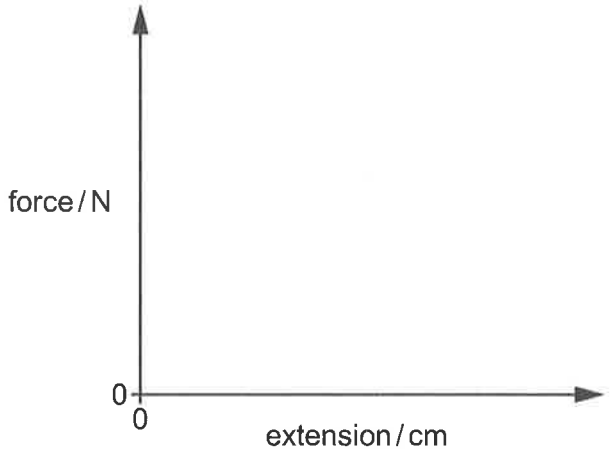

Fig. 2.1

[2]

(ii) State how a force-extension graph can be used to find the elastic potential energy stored in the spring.

.....

..... [1]

(iii) Determine an equation for the elastic potential energy E_p stored in the spring.

The equation must be valid for all extensions up to 10 cm.

Give your answer in terms of the spring constant k and the extension x of the spring.

[2]

(c) A force is applied to the mass, causing the mass to be displaced 3.0 cm downwards from its equilibrium position. This increases the elastic potential energy stored in the spring.

Calculate this increase.

increase in elastic potential energy = ... J [2]

(d) The force is removed. The mass moves upwards.

(i) Calculate the speed at which the mass first moves through its equilibrium position.

Air resistance is negligible.

speed = ... $m s^{-1}$ [2]

(ii) Explain, in terms of energy, what happens as the mass moves upwards from its equilibrium position to its highest vertical displacement.

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.....

.....

..... [3]

[Total: 14]