Old Exam Questions – Old Course

Light Springs and Strings

(M2 Summer 2006)

4. A light elastic string, of natural length 0·8 m and modulus of elasticity 35·4 N, has one end A attached to a fixed point and the other end B attached to a particle P of mass 3 kg. Initially P is held at rest at A. It is then released and allowed to fall. Calculate the speed of P when the length of the string is 1·2 m. [7]

(M2 Summer 2007)

3. The end A of a light elastic string AB, of natural length 0·8 m, is fixed. A particle P, of mass 3 kg, is attached to the end B of the string. Initially, P is held at rest at the point A. It is then released and allowed to fall. The greatest extension of the string in the subsequent motion is 0·4 m.

(a) Show that the modulus of elasticity of the string is 352·8 N. [7]

(b) Find the tension in the string when P is at its lowest point and deduce the magnitude of the acceleration of P in this position. [5]

(M2 Summer 2008)

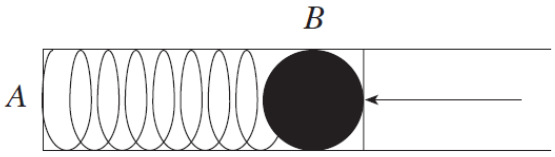
1. An elastic string, of natural length 0·3 m, supports a weight of 12 N hanging freely in equilibrium. The total length of the string is 0·55 m.

(a) Calculate the modulus of elasticity of the string. [3]

(b) Find the elastic energy stored in the string. [3]

(M2 Summer 2009)

2. The diagram shows a spring of natural length of 0·25 m in a smooth horizontal tube with one end A fixed and a small ball bearing B of mass 0·36 kg held in equilibrium by a force of magnitude 80 N compressing it against the free end of the spring. The length of the compressed spring is 0·2 m.



(a) Find the modulus of elasticity of the spring. [3]

(b) The ball bearing is released by removing the force. Find, by using energy considerations, the speed of the ball bearing just as the spring attains its natural length. [5]

(M2 Summer 2010)

3. A particle P, of mass 3 kg, is attached to one end A of a light elastic string of natural length 2 m. The other end B of the string is attached to a point on the ceiling. The modulus of elasticity of the string is 294 N.

(a) The particle P is suspended in equilibrium. Calculate the extension of the string AB with A vertically below B. [3]

(b) The particle P is held at a distance of 1·2 m vertically below B and is then released. Determine the speed of P as it passes through the equilibrium position. [8]

(M2 Summer 2011)

5. A light elastic string, of natural length 1·6 m and modulus of elasticity 80 N, has one end attached to a fixed point A and the other end attached to a particle P, of mass 4 kg. Initially, P is held at a point 0·5 m vertically below the point A. The particle P is released from rest and allowed to fall.

(a) Calculate the tension in the string when the length of the string is 2 m. [2]

(b) Determine the speed of P when the length of the string is 2 m. [8]

(M2 Summer 2012)

2. One end of a light elastic string, of natural length $\frac{5}{3}$ m and modulus of elasticity 245 N, is attached to a fixed point O. The other end of the string is attached to a particle of mass 7·5 kg. The particle hangs in equilibrium vertically below O.

(a) Calculate the extension of the string. [3]

(b) Determine the elastic energy stored in the string. [2]

(M2 Summer 2013)

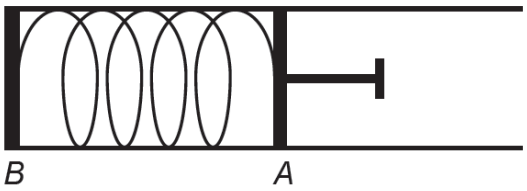
7. The end A of a light elastic string AB, of natural length 1·2 m and modulus of elasticity 360 N, is fixed. A particle P, of mass 2 kg, is attached to the end B. Initially, P is held at rest at a point which is 0·7 m vertically below A. It is then released and allowed to fall.

(a) Find the greatest extension of the string in the subsequent motion. Give your answer correct to 2 decimal places. [7]

(b) Calculate the velocity of the particle when it is 1·2 m below A. [4]

(M2 Summer 2014)

1. The diagram shows a piston, of mass 0·8 kg, enclosed in a horizontal tube and attached to a light spring of natural length 0·2 m and modulus of elasticity 625 N. The other end of the spring is fixed to the end of the tube at point *B*.



Initially, the piston is held at rest at a point *A* with the spring compressed a distance of 0·1 m, so that *AB* is the compressed length of the spring.

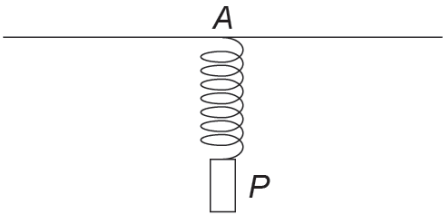
(a) Calculate the elastic energy stored in the spring. [2]

The piston is then released. During the subsequent motion, it is subjected to a resistance to motion of constant magnitude 46 N.

(b) Determine the velocity of the piston when the spring reaches its natural length. [5]

(M2 Summer 2015)

5. The diagram shows a light spring of natural length 0·4 m and modulus of elasticity 1470 N with one end *A* fixed and the other end attached to an object *P* of mass 15 kg.



Initially, *P* hangs in equilibrium with the spring vertical.

(a) Determine the extension of the spring. [3]

The object *P* is pulled downwards so that the total length of the spring is 0·56 m. It is then released.

(b) Calculate the speed of *P* when it is at a distance 0·45 m from *A*. [8]

(M2 Summer 2016)

5. A particle is attached to one end of a light elastic string of natural length l m and modulus of elasticity λ N. The other end of the string is attached to the ceiling. The particle hangs in equilibrium. The length of the string is 0·95 m when the weight of the particle is 30 N, and 1·15 m when the weight of the particle is 70 N. Find the value of l and the value of λ. [6]

(M2 Summer 2018)

5. A light elastic string, of natural length 1·2 m and modulus of elasticity 60 N, has one end A attached to a fixed point and the other end B attached to a particle P of mass 3 kg. Initially P is held at a point which is 0·6 m vertically below A. It is then released and allowed to fall. Calculate the speed of P when the length of the string is 1·5 m. [8]