

QQQ – Further Mechanics 1 – Chapter 3 – Elastic Strings, Springs & Hooke's Law (Version 1)

Total Marks: 23

(23 = Platinum, 21 = Gold, 18 = Silver, 16 = Bronze)

1. A light elastic string of natural length 0.4 m has one end A attached to a fixed point. The other end of the string is attached to a particle P of mass 2 kg. When P hangs in equilibrium vertically below A , the length of the string is 0.56 m.

(a) Find the modulus of elasticity of the string. (3)

A horizontal force is applied to P so that it is held in equilibrium with the string making an angle θ with the downward vertical. The length of the string is now 0.72 m.

(b) Find the angle θ . (3)

(Total 6 marks)

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2.

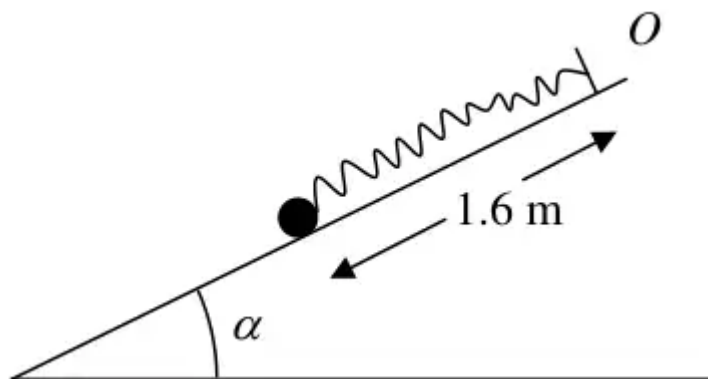


Figure 1

A particle of mass 0.8 kg is attached to one end of a light elastic spring, of natural length 2 m and modulus of elasticity 20 N. The other end of the spring is attached to a fixed point O on a smooth plane which is inclined at an angle α to the horizontal, where $\tan \alpha = \frac{3}{4}$. The particle is held on the plane at a point which is 1.6 m down a line of greatest slope of the plane from O , as shown in Figure 1. The particle is then released from rest.

Find the initial acceleration of the particle. (6)

(Total 6 marks)

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3. A light elastic string with natural length l and modulus of elasticity kmg has one end attached to a fixed point A on a rough inclined plane. The other end of the string is attached to a package of mass m .

The plane is inclined at an angle θ to the horizontal, where $\tan \theta = \frac{5}{12}$

The package is initially held at A . The package is then projected with speed $\sqrt{6gl}$ up a line of greatest slope of the plane and first comes to rest at the point B , where $AB = 3l$.

The coefficient of friction between the package and the plane is $\frac{1}{4}$

By modelling the package as a particle,

(a) show that $k = \frac{15}{26}$ **(6)**

(b) find the acceleration of the package at the instant it starts to move back down the plane from the point B . **(5)**

(Total 11 marks)