

QQQ – Further Mechanics 1 – Chapter 3 – Elastic Strings, Springs & Hooke's Law (Version 2)

Total Marks: 25

(25 = Platinum, 23 = Gold, 20 = Silver, 17 = Bronze)

1. A particle of mass 0.8 kg is attached to one end of a light elastic string of natural length 0.6 m. The other end of the string is attached to a fixed point A . The particle is released from rest at A and comes to instantaneous rest 1.1 m below A .

Find the modulus of elasticity of the string.

(4)

(Total 4 marks)

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2. A light elastic string has natural length 8 m and modulus of elasticity 80 N. The ends of the string are attached to fixed points P and Q which are on the same horizontal level and 12 m apart. A particle is attached to the mid-point of the string and hangs in equilibrium at a point 4.5 m below PQ .

(a) Calculate the weight of the particle.

(6)

(b) Calculate the elastic energy in the string when the particle is in this position.

(3)

(Total 9 marks)

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3. A spring of natural length a has one end attached to a fixed point A . The other end of the spring is attached to a package P of mass m .

The package P is held at rest at the point B , which is vertically below A such that $AB = 3a$.

After being released from rest at B , the package P first comes to instantaneous rest at A .

Air resistance is modelled as being negligible.

By modelling the spring as being light and modelling P as a particle,

(a) show that the modulus of elasticity of the spring is $2mg$ **(5)**

(b) (i) Show that P attains its maximum speed when the extension of the spring is $\frac{1}{2}a$

(ii) Use the principle of conservation of mechanical energy to find the maximum speed, giving your answer in terms of a and g .

(6)

In reality, the spring is not light.

(c) State one way in which this would affect your energy equation in part (b). **(1)**

(Total 12 marks)