Energy - Exercises (2 pages; 6/4/20)

- incl. Hooke's law

(1***) A particle of mass 200g is attached at the mid-point of an elastic string of natural length 0.5m and modulus of elasticity λ, which hangs vertically between two points, 1m apart.

(i) How far will the particle be below the top point if $\lambda = 1$?

(ii) Determine the minimum value of λ such that there is no slack in the string.

(2***) A particle of mass 200g hangs at a point Q, suspended from a fixed point P, by means of a spring of original length 20cm and modulus of elasticity 5N. It is pulled down to a point R, which is 35cm below P. The particle is then released.

Ignoring any resistances to motion, find:

(i) the work done in pulling the particle down to R

(ii) the maximum speed of the particle after it is released, and the point at which this occurs

(iii) the distance of the particle below P when it reaches its maximum height, at position S, and show that the distance QS equals the distance QR

(3***) A bungee jumper of mass 80kg is attached to a rope of original length 10m and modulus of elasticity 1600N. How far will he or she fall? (Take g=10)

(4***) Two elastic strings AB and BC are joined together at B, to form one long string. String AB has natural length $4m$ and modulus of elasticity $20N$; string BC has natural length $2m$ and modulus of elasticity $30N$. The ends A and C of the long string are attached to two fixed points which are $10m$ apart. Find the tension in the combined string.

(5***) A car of mass 1 tonne starts to climb a hill at $20ms^{-1}$. The slope of the hill is a constant θ, where $sin\theta = \frac{1}{10}$. If the car is not accelerating (or braking) and there is a constant resistance to motion of $1000N$, find the speed of the car when it has gained a height of $5m$. Assume that $g = 10$.