

## STEP III, 2013 , Q11

- 11 An equilateral triangle, comprising three light rods each of length  $\sqrt{3}a$ , has a particle of mass  $m$  attached to each of its vertices. The triangle is suspended horizontally from a point vertically above its centre by three identical springs, so that the springs and rods form a tetrahedron. Each spring has natural length  $a$  and modulus of elasticity  $kmg$ , and is light. Show that when the springs make an angle  $\theta$  with the horizontal the tension in each spring is

$$\frac{kmg(1 - \cos \theta)}{\cos \theta}.$$

Given that the triangle is in equilibrium when  $\theta = \frac{1}{6}\pi$ , show that  $k = 4\sqrt{3} + 6$ .

The triangle is released from rest from the position at which  $\theta = \frac{1}{3}\pi$ . Show that when it passes through the equilibrium position its speed  $V$  satisfies

$$V^2 = \frac{4ag}{3}(6 + \sqrt{3}).$$



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