

AQA – Differential equations – A2 Further Mathematics P11. [June/2021/Paper_7367/1/No.15](#)

In this question use $g = 9.8 \text{ m s}^{-2}$

A particle P of mass m is attached to two light elastic strings, AP and BP .

The other ends of the strings, A and B , are attached to fixed points which are 4 metres apart on a rough horizontal surface at the bottom of a container.

The coefficient of friction between P and the surface is 0.68

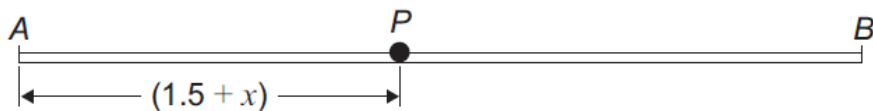
- When the extension of string AP is e_A metres, the tension in AP is $24me_A$
- When the extension of string BP is e_B metres, the tension in BP is $10me_B$
- The natural length of string AP is 1 metre
- The natural length of string BP is 1.3 metres



- (a) Show that when $AP = 1.5$ metres, the tension in AP is equal to the tension in BP . [1 mark]

- (b) P is held at the point between A and B where $AP = 1.9$ metres, and then released from rest.

At time t seconds after P is released, $AP = (1.5 + x)$ metres.



Show that when P is moving towards A ,

$$\frac{d^2x}{dt^2} + 34x = 6.664$$

[3 marks]

- (c) The container is then filled with oil, and P is again released from rest at the point between A and B where $AP = 1.9$ metres.

At time t seconds after P is released, the oil causes a resistive force of magnitude $10mv$ newtons to act on the particle, where $v \text{ m s}^{-1}$ is the speed of the particle.

Find x in terms of t when P is moving towards A .

[9 marks]