7. A particle P of mass m is attached to one end of a light elastic string of natural length l. The other end of the string is attached to a fixed point on a ceiling. The particle P hangs in equilibrium at a distance D below the ceiling.

The particle P is now pulled vertically downwards until it is a distance $3l$ below the ceiling and released from rest.

Given that P comes to instantaneous rest just before it reaches the ceiling,

(a) show that $D = \frac{5l}{3}$

(6)

(b) Show that, while the elastic string is stretched, P moves with simple harmonic motion, with period $2\pi\sqrt{\frac{2l}{3g}}$

(6)

(c) Find, in terms of g and l, the exact time from the instant when P is released to the instant when the elastic string first goes slack.

(4)

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TOTAL FOR PAPER IS 75 MARKS

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