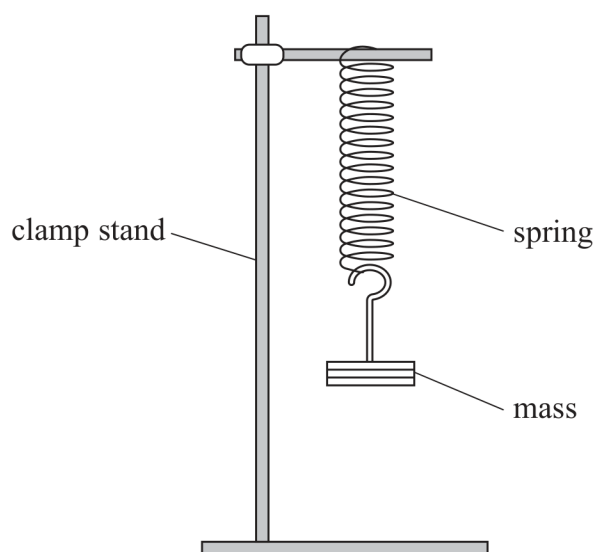17 A student suspended a spring from a rigid support. She stretched the spring by hanging a mass from the free end of the spring as shown.

clamp stand — spring

mass

She set the mass into vertical oscillations by displacing it a small distance from its equilibrium position. The spring obeys Hooke's law.

(a) Explain why the mass moves with simple harmonic motion.

(2)

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(b) When the mass on the end of the spring was $0.200\,kg$, the extension of the spring was $7.50\,cm$ when the mass was in equilibrium.

(i) Show that the stiffness k of the spring is about $26\,N\,m^{-1}$.

(2)

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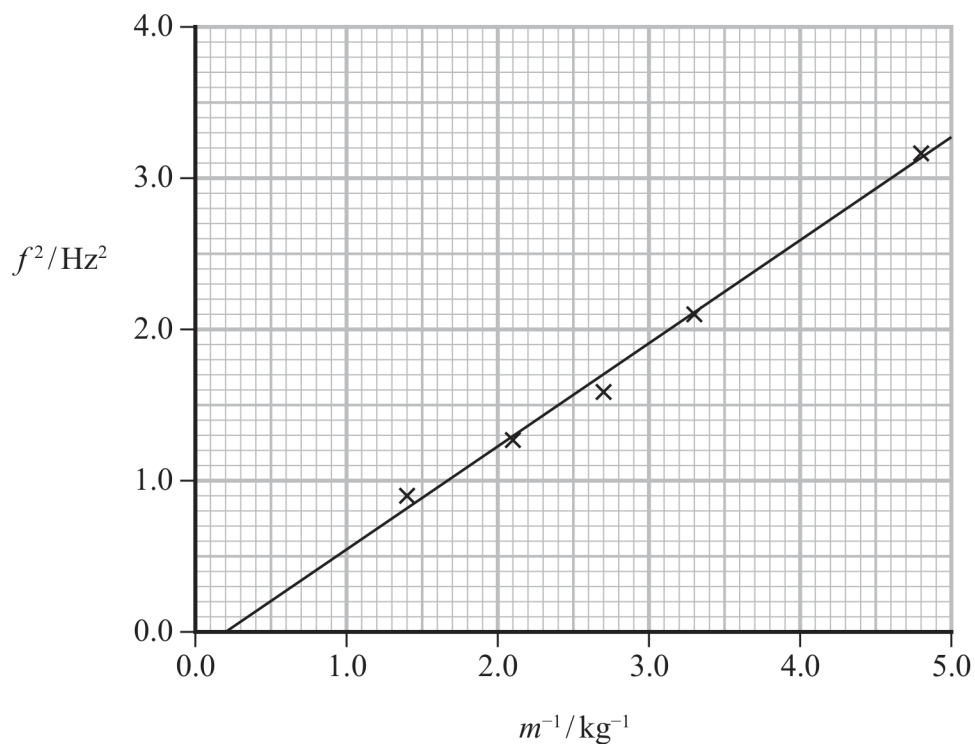
(ii) The student used a stopwatch to determine the frequency of oscillation f of the mass m.

She repeated this procedure for four more values of m and obtained the following graph.

The student used the graph to determine a value for k.

Deduce whether the graph gives a value of k consistent with the value in (i).

(6)

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(Total for Question 17 = 10 marks)