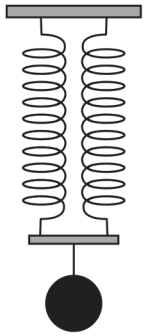
19 A student hangs a mass of 0.22 kg from two identical springs as shown.



She displaces the mass vertically and the mass oscillates with simple harmonic motion.

(a) The student measures the time t for the mass to complete 30 oscillations. She repeats this measurement.

Her measurements are given in the table.

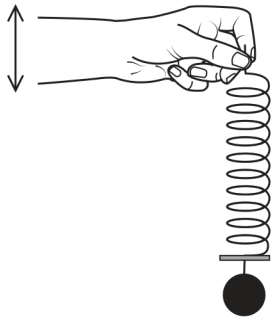
t_1 / s	t_2 / s
13.65	13.70

The springs are taken from a box labelled $k = 21\,\text{N m}^{-1}$.

Deduce whether the value of k stated on the label is correct.

(4)

(b) The student attaches the mass to one spring and holds the other end. She sets the mass into oscillation by oscillating her hand vertically, as shown.



The student increases the frequency at which she oscillates her hand. She keeps the amplitude of oscillation of her hand constant.

She observes that the amplitude of oscillation of the mass increases to a maximum and then decreases.

(i) Explain this observation.

(3)

(ii) The student makes the following conclusion:

"As the frequency is increased, the amplitude of the mass increases to a maximum, so energy conservation does not apply to this situation."

Explain whether her conclusion is correct.

(3)

(Total for Question 19 = 10 marks)