1 An experiment is performed to determine the period of an oscillating system. It involves two objects connected by a light spring sliding on a smooth surface as shown in Fig. 1.1. The two objects are pushed towards the spring before being released to start the oscillation.

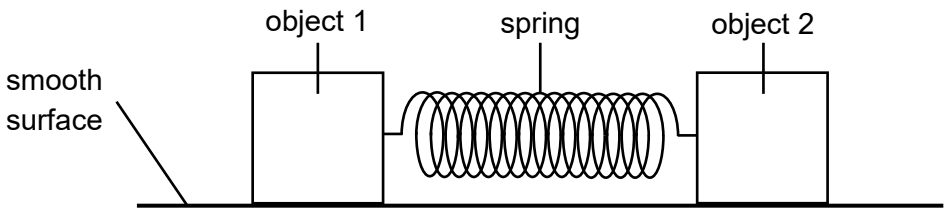

Fig. 1.1

The following equation describes the period of the oscillation, T .

$$T = 2\pi\sqrt{\frac{m_1 m_2}{k\left(m_1 + m_2\right)}}$$

where

mass of object 1, $m_1 = \left(500 \pm 1\right)$ g ,

mass of object 2, $m_2 = \left(1167 \pm 1\right)$ g , and

spring constant, $k = \left(8.0 \pm 0.2\right)$ N m^{-1} .

(a) (i) State the absolute uncertainty of $m_1 + m_2$.

absolute uncertainty = …… g [1]

(ii) Hence, or otherwise, determine the percentage uncertainty of T.

percentage uncertainty = …… % [3]

(b) A student plans to measure the total time for 20 oscillations before calculating the average time for one oscillation. The total time recorded on the stopwatch is 26.30 s and the uncertainty in the measurement is estimated to be ± 0.4 s.

(i) Explain, with calculations, the advantage of calculating the average time from 20 oscillations instead of measuring the time for one oscillation.

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(ii) In reality, the student mistook the time for half an oscillation to be one period.

State the percentage error in the measurement of the period due to this mistake.

percentage error = …… % [1]

(iii) Explain whether calculating the average time from the total time taken for multiple oscillations will reduce the error committed in **(b)(ii)**.

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