3 **(a)** State Hooke's law.

....

....[1]

(b) The variation with compression x of the force F acting on a spring is shown in Fig. 3.1.

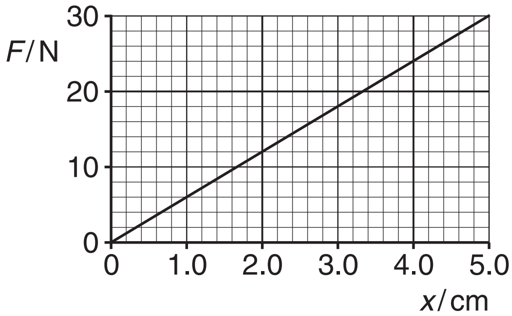

Fig. 3.1

The spring is fixed to the closed end of a horizontal tube. A block is pushed into the tube so that the spring is compressed, as shown in Fig. 3.2.

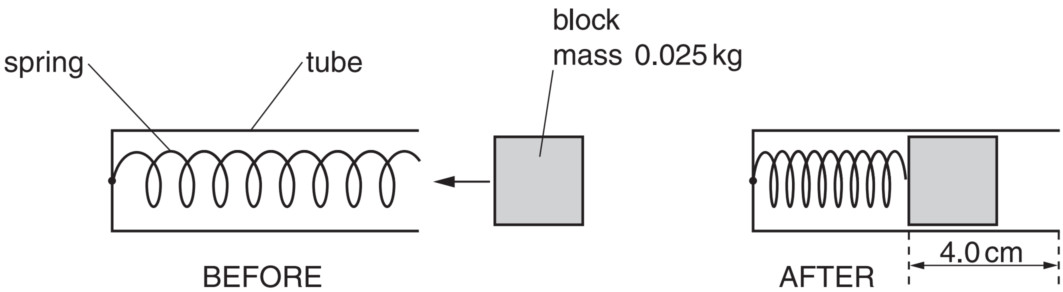

Fig. 3.2 (not to scale)

The compression of the spring is 4.0 cm. The mass of the block is 0.025 kg.

(i) Calculate the spring constant of the spring.

spring constant = ... $N\,m^{-1}$ [2]

(ii) Show that the work done to compress the spring by 4.0 cm is 0.48 J.

[2]

(iii) The block is now released and accelerates along the tube as the spring returns to its original length. The block leaves the end of the tube with a speed of $6.0\,\mathrm{m\,s^{-1}}$.

1. Calculate the kinetic energy of the block as it leaves the end of the tube.

kinetic energy = ... J [2]

2. Assume that the spring has negligible kinetic energy as the block leaves the tube. Determine the average resistive force acting against the block as it moves along the tube.

resistive force = ... N [3]

(iv) Determine the efficiency of the transfer of elastic potential energy from the spring to the kinetic energy of the block.

efficiency = ... [2]

[Total: 12]