Answer **all** the questions in the spaces provided.

1   A spring has an unstretched length of 8.0 cm. The top of the spring is attached to a fixed point.

A steel block of mass 140 g is suspended from the lower end so that the length of the spring increases to 10.8 cm, as shown in Fig. 1.1.
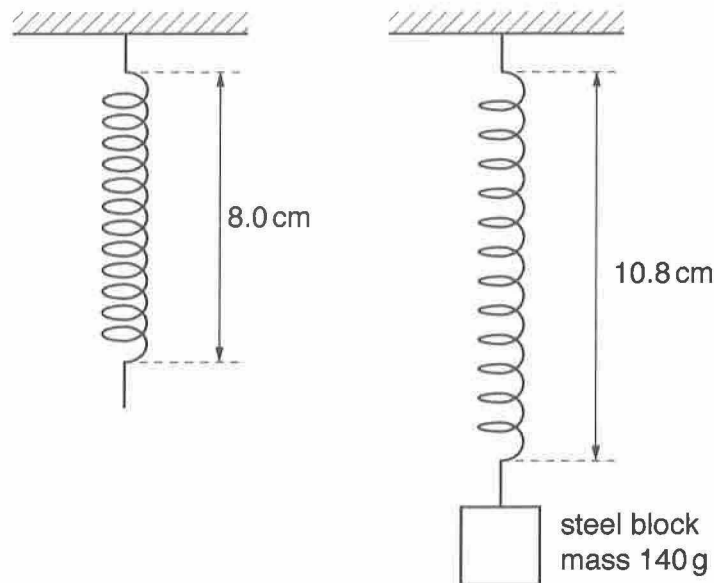

Fig. 1.1

Fig. 1.1 is not to scale.

(a) Calculate the force constant of the spring.

force constant = ... N m^{-1} [2]

(b) (i) The percentage uncertainty in the mass is ±1.0%. The actual uncertainty in each measurement of the length of the spring is ±1 mm.

Calculate the percentage uncertainty in the force constant.

percentage uncertainty = ... % [2]

(ii) Use your answers in **(a)** and **(b)(i)** to determine the value of the force constant, with its actual uncertainty, to an appropriate number of significant figures.

force constant = ... ± .... $N\,m^{-1}$ [1]

(c) The block is submerged in liquid. The length of the spring is now 10.3 cm, as shown in Fig. 1.2.
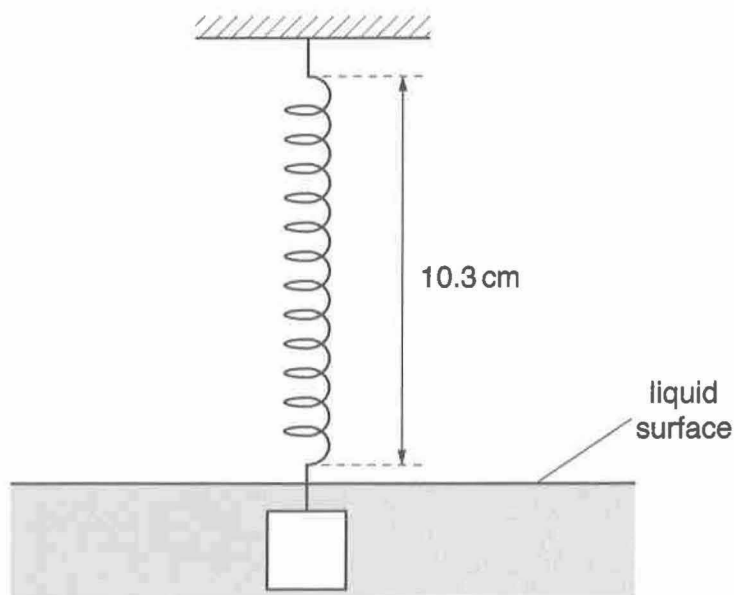

10.3 cm

liquid surface

Fig. 1.2

(i) Show that the upthrust acting on the block is approximately 0.25 N.

[1]

(II) The block has density 7750 kg m^{-3}.

Determine the density of the liquid.

density = ... kg m^{-3} [3]