2 A spring of length 5.0 cm is extended by a force. The variation with extension x of the force F is shown in Fig. 2.1.

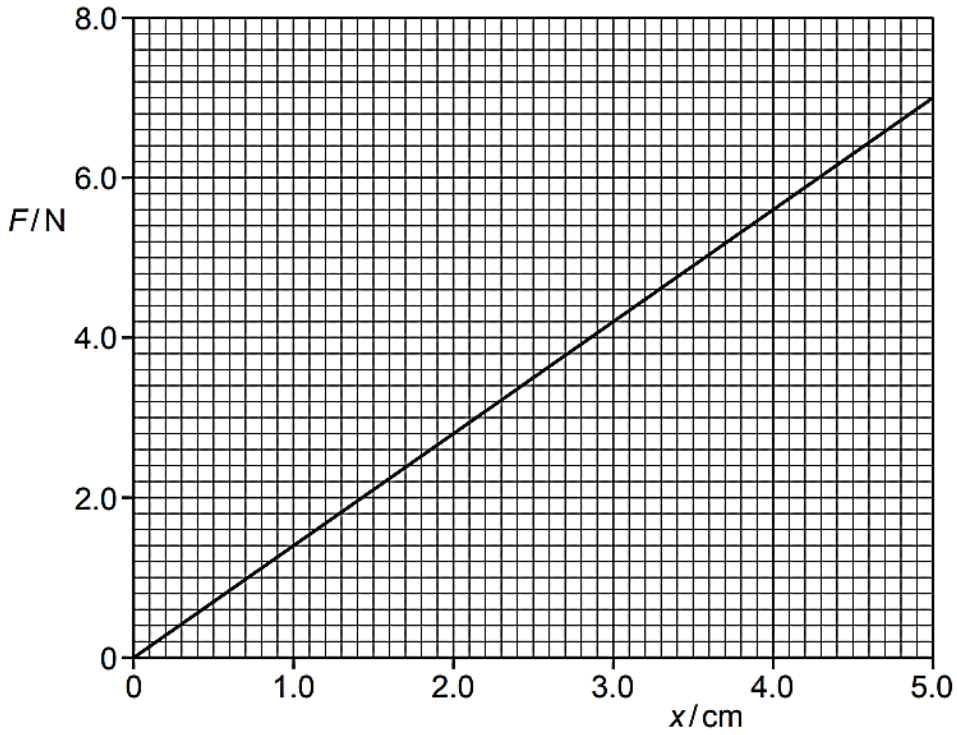

Fig. 2.1

(a) Describe how the graph in Fig. 2.1 shows that the spring obeys Hooke's law.

……

…… [1]

(b) Determine:

(i) the spring constant of the spring.

spring constant = …… N m^{-1} [1]

(ii) the elastic potential energy in the spring when x = 4.0 cm.

elastic potential energy = …… J [1]

(c) One end of the spring is attached to a fixed point. A cylinder that is submerged in a liquid is now suspended from the other end of the spring, as shown in Fig. 2.2.

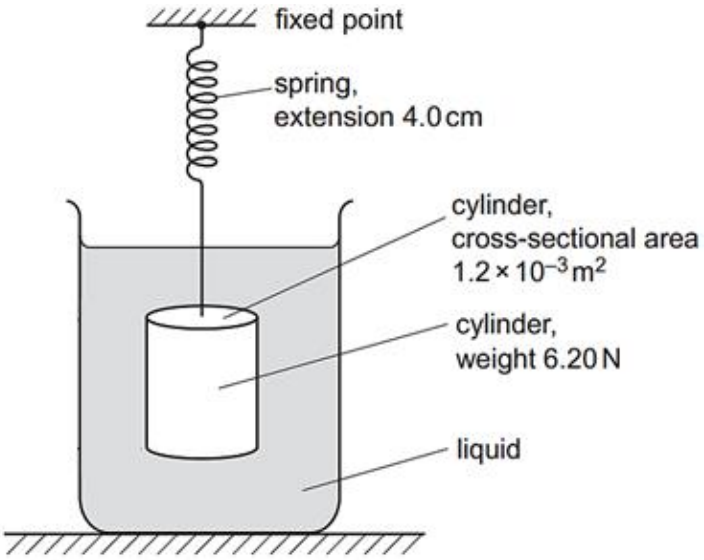

Fig. 2.2

The cylinder has a cross-sectional area 1.2×10^{-3} m^2 and weight 6.2 N. The cylinder is in equilibrium when the extension of the spring is 4.0 cm.

(i) Determine the upthrust acting on the cylinder.

upthrust = ……... N [1]

(ii) Calculate the difference in pressure between the bottom face and the top face of the cylinder.

difference in pressure = …… Pa [2]

(d) State and explain the effect, if any, on the extension of the spring if the liquid in **(c)** is replaced by another liquid of greater density with the cylinder still fully submerged.

……

……

…… [2]

(e) The weight of the cylinder is given by

$$W = \pi r^2 h \rho g$$

where W is the weight of the cylinder, r is the radius of the cylinder, h is the height of the cylinder, ρ is the density of cylinder and g is the acceleration of free fall.

Data for the cylinder is shown in Table 2.3.

Table 2.3

quantity	magnitude	uncertainty
W/N	6.2	± 0.4
r/m	1.95×10^{-2}	$\pm 0.03 \times 10^{-2}$
ρ/kg m^{-3}	7800	± 300

The value of h can be determined using the data given above.

Determine the percentage uncertainty associated to h.

percentage uncertainty = …… % [2]

[Total: 10]