3 A spring is extended by a force. The variation with extension x of the force F is shown in Fig. 3.1.

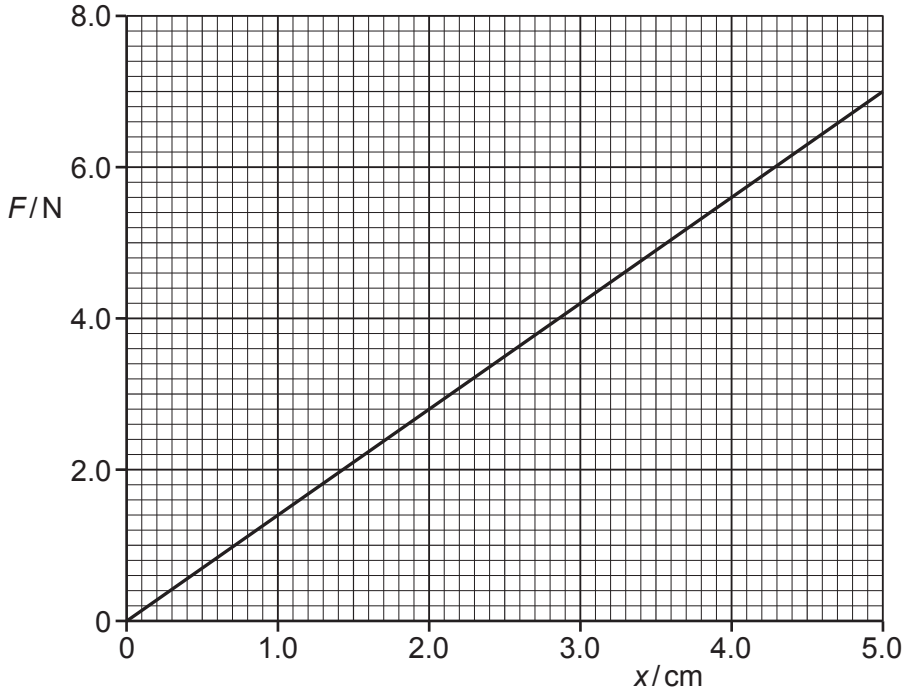

Fig. 3.1

(a) State the name of the law that relates the force and extension of the spring shown in Fig. 3.1.

..... [1]

(b) Determine:

(i) the spring constant, in $N\,m^{-1}$, of the spring

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

(ii) the strain energy (elastic potential energy) in the spring when the extension is 4.0 cm.

strain energy = ... J [2]

(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. 3.2.

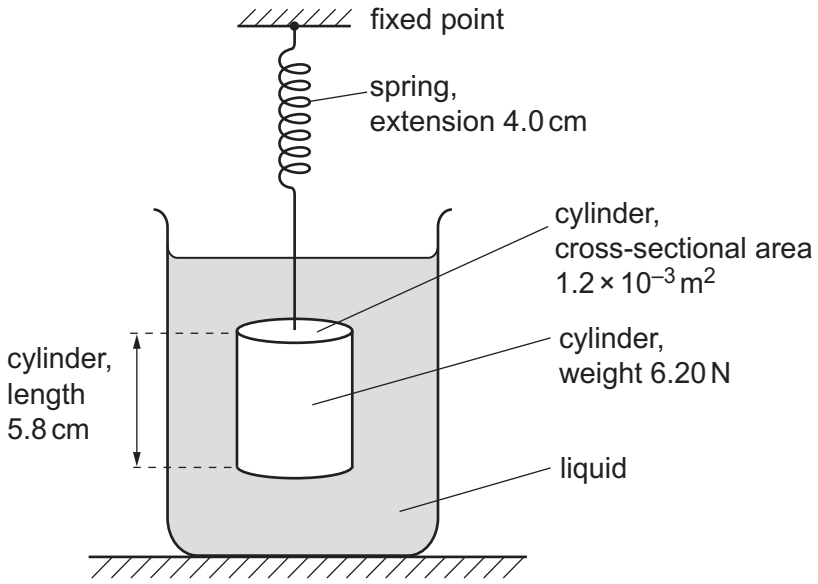

Fig. 3.2

The cylinder has length 5.8 cm, cross-sectional area $1.2 \times 10^{-3}\,m^2$ and weight 6.20 N. The cylinder is in equilibrium when the extension of the spring is 4.0 cm.

(i) Show that the upthrust acting on the cylinder is 0.60 N.

[1]

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

difference in pressure = ... Pa [2]

(iii) Calculate the density of the liquid.

density = ... $kg\,m^{-3}$ [2]

(d) The liquid in **(c)** is replaced by another liquid of greater density.

State the effect, if any, of this change on:

(i) the upthrust acting on the cylinder

..... [1]

(ii) the extension of the spring.

..... [1]

[Total: 12]