3 **(a)** Determine the SI base units of the moment of a force.

SI base units : ……………………………… [1]

(b) A uniform square sheet of card ABCD is freely pivoted by a pin at a point P. The card is held in a vertical plane by an external force in the position shown in Fig. 3.1.
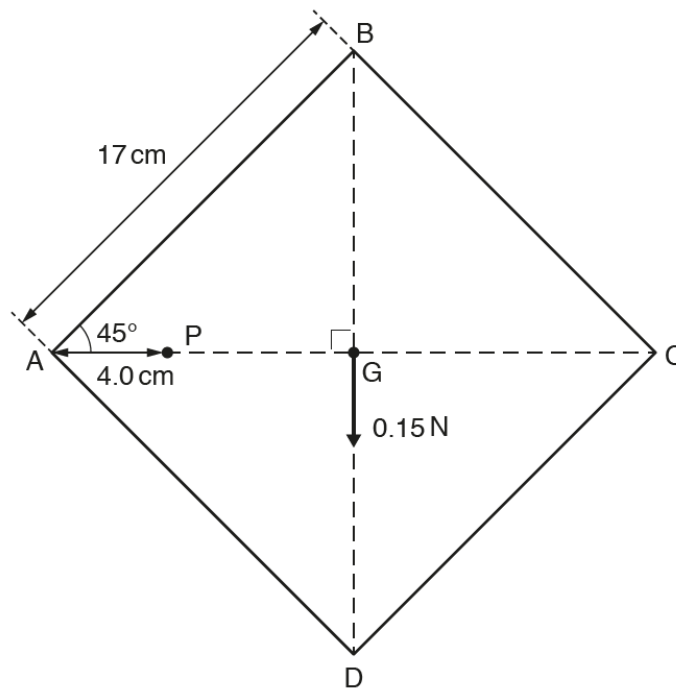

Fig. 3.1 (not to scale)

The card has weight 0.15 N which may be considered to act at the centre of gravity G. Each side of the card has length 17 cm. Point P lies on the horizontal line AC and is 4.0 cm from corner A. Line BD is vertical.

The card is released by removing the external force. The card then swings in a vertical plane until it comes to rest.

(i) Calculate the magnitude of the resultant moment about point P acting on the card immediately after it is released.

moment = …………….…………….N m [2]

(ii) Explain why, when the card has come to rest, its centre of gravity is vertically below point P.

....

....

....

.... [2]

(c) A spring is extended by a force. The variation with extension x of the force F is shown in Fig. 3.2.
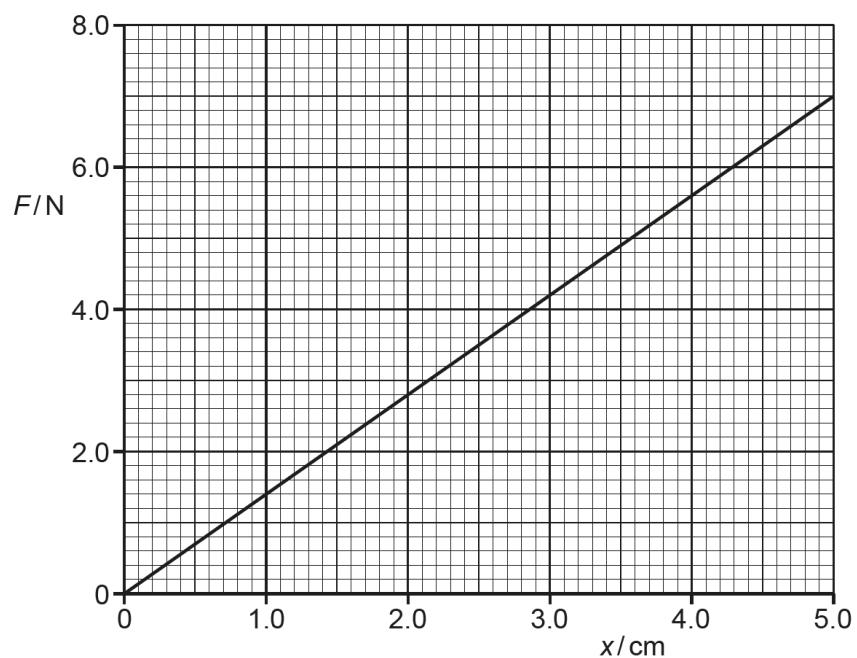

Fig. 3.2

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. 3.3.
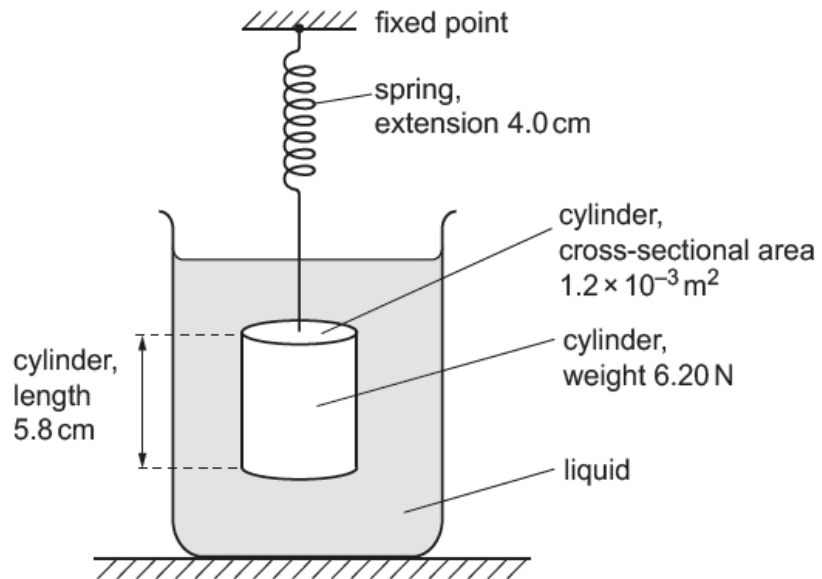

Fig. 3.3

The cylinder has length 5.8 cm, cross-sectional area 1.2 × 10⁻³ m² and weight 6.20 N. The cylinder is in equilibrium when the extension of the spring is 4.0 cm.

(i) Calculate the upthrust acting on the cylinder.

upthrust = ………………………….N [2]

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

difference in pressure = …………………………….Pa [2]

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

State and explain the effect, if any, of this change on the extension of the spring.

....

....

.... [2]

[Total: 11]