2 **(a)** State the two conditions necessary for a rigid body to be in equilibrium.

1. ....
......

....
.....

2. ....
...

....
...[2]

(b) A horizontal force *F* is applied on a cube which remains stationary, as shown in Fig. 2.1. G is the centre of mass of the cube and is located at its geometric centre. The line of action of *F* is midway between G and the top of the cube.

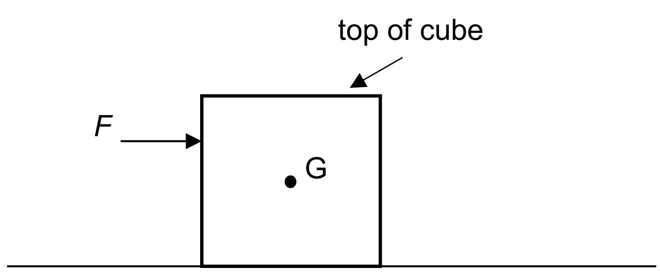

Fig. 2.1

(i) On Fig. 2.1, draw the following forces acting on the cube:

1. Weight of the cube, labelled as *W*. [1]

2. Resultant force, labelled as *R*, that the ground exerts on the cube. [2]

(ii) If the mass of the cube is 200 g, calculate the maximum value of *F* such that the cube does not rotate.

maximum value of *F* = ... N [2]

(c) A spring has an unstretched length of 8.0 cm. One end of the spring is fixed to a support and a mass of 140 g is attached to the other end of the spring. The length of the spring is now 10.8 cm.

Calculate the force constant of the spring.

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

(d) The cube in **(b)** is now attached to one end of the spring in **(c)** and is submerged in a liquid, as shown in Fig. 2.2. The length of the spring is now 10.3 cm.

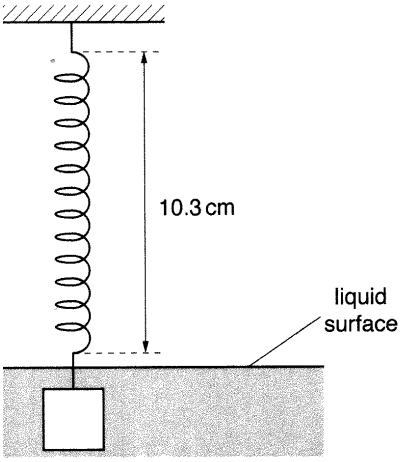

Fig. 2.2

(i) Show that the upthrust acting on the cube is approximately 0.83 N. [1]

(ii) The cube is made of concrete which has a density of 2.4 g cm^{-3}.

Determine the density of the liquid.

density = …… kg m^{-3} [2]