3 **(a)** State **two** conditions for an object to be in equilibrium.

1. .....

.....

2. .....

.....

[2]

(b) A sphere of weight 2.4 N is suspended by a wire from a fixed point P. A horizontal string is used to hold the sphere in equilibrium with the wire at an angle of 53° to the horizontal, as shown in Fig. 3.1.

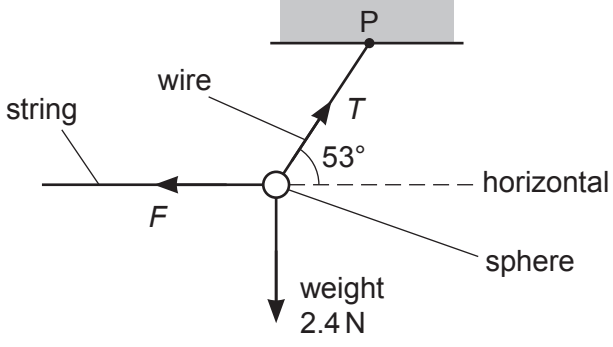

Fig. 3.1 (not to scale)

(i) Calculate:

1. the tension T in the wire

T = ... N

2. the force F exerted by the string on the sphere.

F = ... N

[2]

(ii) The wire has a circular cross-section of diameter 0.50 mm. Determine the stress σ in the wire.

σ = ... Pa [3]

(c) The string is disconnected from the sphere in **(b)**. The sphere then swings from its initial rest position A, as illustrated in Fig. 3.2.

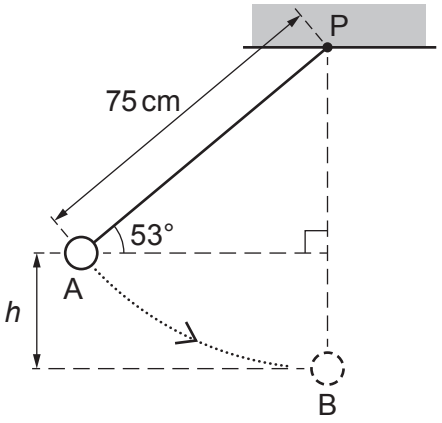

Fig. 3.2 (not to scale)

The sphere reaches maximum speed when it is at the bottom of the swing at position B. The distance between P and the centre of the sphere is 75 cm.
Air resistance is negligible and energy losses at P are negligible.

(i) Show that the vertical distance *h* between A and B is 15 cm.

[1]

(ii) Calculate the change in gravitational potential energy of the sphere as it moves from A to B.

change in gravitational potential energy = ... J [2]

(iii) Use your answer in **(c)(ii)** to determine the speed of the sphere at B.
Show your working.

speed = ... $m\,s^{-1}$ [3]

[Total: 12]