2 **(a)** State what is meant by the centre of gravity of an object.

.....

..... [1]

(b) A non-uniform rod XY is pivoted at point P, as shown in Fig. 2.1.

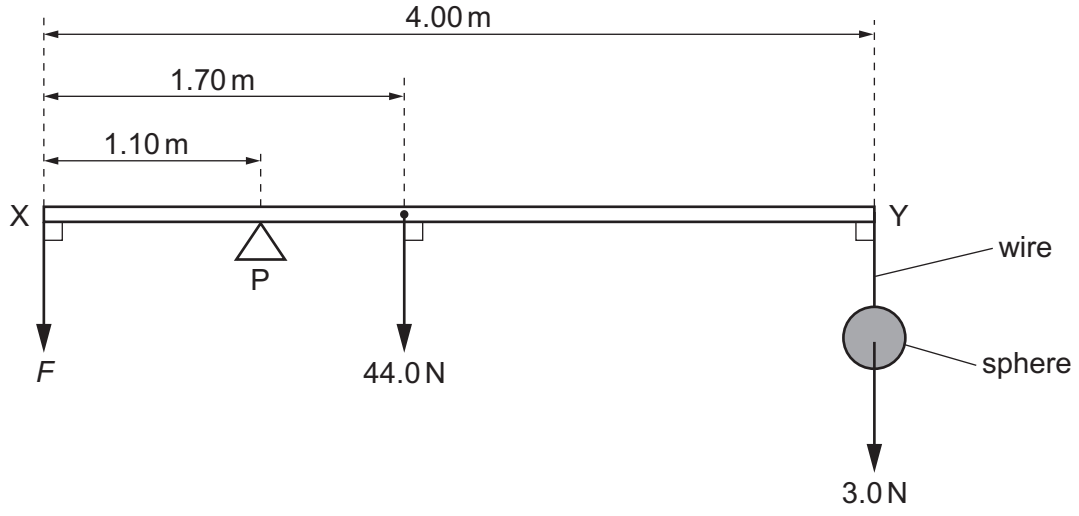

Fig. 2.1 (not to scale)

The rod has length 4.00 m and weight 44.0 N. The centre of gravity of the rod is 1.70 m from end X of the rod. Point P is 1.10 m from end X.

A sphere hangs by a wire from end Y of the rod. The weight of the sphere is 3.0 N. The weight of the wire is negligible.

A force *F* is applied vertically downwards at end X so that the horizontal rod is in equilibrium.

(i) By taking moments about P, calculate *F*.

F = ... N [3]

(ii) Calculate the force exerted on the rod by the pivot.

force = ... N [1]

(c) The sphere in **(b)** is now immersed in a liquid in a container, as shown in Fig. 2.2.

Fig. 2.2

The density of the liquid is 1100 kg m^{-3}. The upthrust acting on the sphere due to the liquid is 2.5 N. The magnitude of F is unchanged so that the horizontal rod is **not** in equilibrium.

(i) Use Archimedes' principle to determine the radius r of the sphere.

r = ... m [3]

(ii) Calculate the magnitude and direction of the resultant moment of the forces on the rod about P.

magnitude of resultant moment = ... N m

direction of resultant moment .....

[2]

[Total: 10]