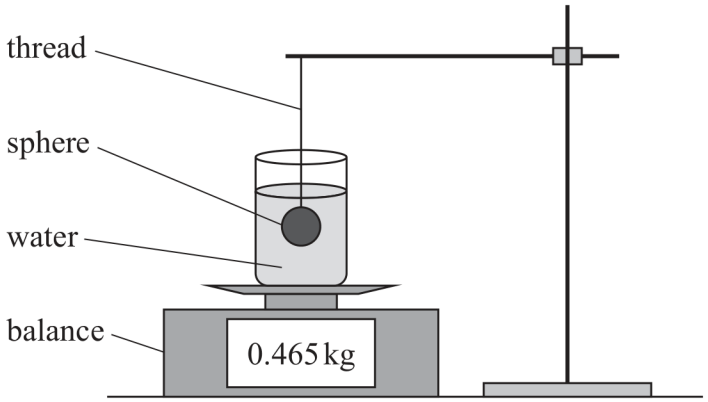
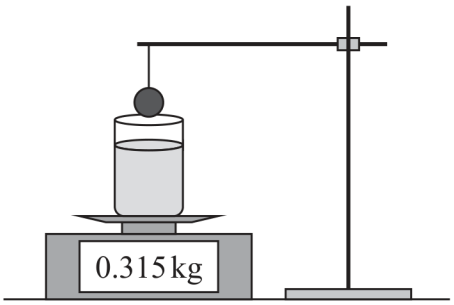
19 A student used the apparatus shown to investigate the forces acting on a uniform, solid sphere placed in water.

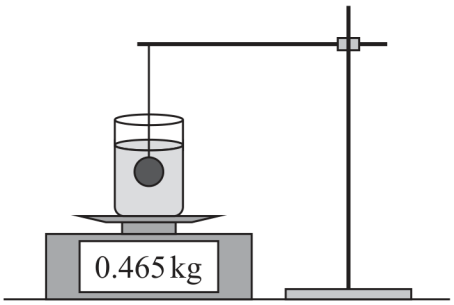


(a) Draw a free-body force diagram for the sphere when it is suspended in water as shown.

(3)

(b) As the sphere was lowered into the water, the reading on the balance increased from 315 g to 465 g as shown.





(i) Explain the increase in the reading on the balance. Your answer should include a reference to Newton's third law.

(3)

(ii) Determine the mass of the sphere.

density of water $= 1000\,\text{kg}\,\text{m}^{-3}$
density of sphere $= 2000\,\text{kg}\,\text{m}^{-3}$

(4)

Mass of sphere = ...

(iii) The water was replaced with the same mass of oil and the experiment repeated. The density of the oil is less than the density of water.

Explain what happens to the final reading on the balance.

(2)

(Total for Question 19 = 12 marks)