

20 In the 18th century, Cavendish carried out the first experiment to determine the gravitational constant G . The experiment used two lead spheres.

- (a) A physicist planned to investigate the gravitational force using lead spheres identical to the ones used in Cavendish's original experiment.

One of the spheres had a diameter of 30.5 cm and a mass of 158 kg.

The second sphere had a diameter of 2.5 cm and a mass of 0.73 kg.

The minimum force that could be measured by the physicist was $50\text{ }\mu\text{N}$.

Deduce whether the physicist would be able to measure the gravitational force between the two spheres.

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- (b) Experiments to determine G have usually been carried out using large masses.

In 2021 physicists at the University of Vienna carried out an experiment to determine G using gold spheres with masses of less than 100 mg.

They obtained a value for G equal to $6.04 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$.

- (i) Show that $\text{m}^3 \text{ kg}^{-1} \text{ s}^{-2}$ is a correct unit for G .

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- (ii) The physicists concluded that their value for G was within reasonable agreement with the standard value of G .

Evaluate the validity of their conclusion.

$$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$$

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