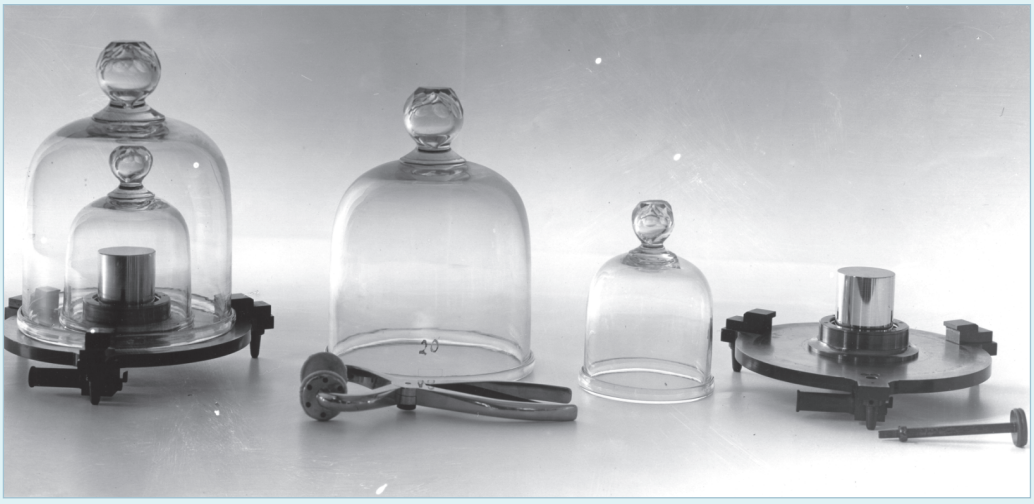
THE EXACT MASS OF A KILOGRAM: LE GRAND K

We've all been grocery shopping and heard that the price of tomatoes, for example, is Rs. 15/kg. While we know that a kilogram is the standard unit of mass, have you ever wondered how it is measured? How do the weights in all the grocery stores across the world agree with each other?

It is in response to questions like this that the 1st General Conference on Weights and Measures (CGPM), held in 1889, declared a platinum-iridium cylinder as the International Prototype of the Kilogram (IPK). Ever since, a kilogram has been defined as the exact mass of this small cylinder, with both a height and diameter of 39.17 mm, that is often called Le Grand K.

To protect the Le Grand K against corrosion by moisture and contamination by dust, it is kept sealed within a series of three Russian-doll like glass bell jars in a climate-controlled room in Paris, France. This room can only be unlocked by a gathering of three custodians, each using a different key. To ensure consistency, 40 identical copies of this cylinder were shipped to other countries, including India, to serve as national standards. To identify any discrepancies in mass, the copies have been reunited with Le Grand K three times in the last century, and their masses have been compared and re-calibrated. On each such occasion, contamination has been minimized by gently wiping the original and its copies with alcohol and ether before steam-cleaning them. Problem solved, right?



Le Grand K are used as national standards. The platinum-iridium cylinder to the extreme right is the copy (called Kilogram No. 20) used as the national standard of the kilogram in USA. The cylinder to the extreme left and under a bell jar (called Kilogram No. 4) is a duplicate of Kilogram No. 20 that is used as a secondary standard.

Well, not really. In spite of these precautions, careful measurements in 1992 showed that Le Grand K was lighter than its copies by about 50 micrograms (about the weight of an eyelash). While this may not seem relevant in everyday transactions like grocery shopping, it is unacceptable in fields, like medicine and engineering, which require extreme precision. More importantly, the kilogram is an SI base unit – which means that other quantities, such as newton, joule, and pascal, are derived in part from it. Thus, any inaccuracy in this unit is likely to have a considerable ripple effect.

How do we address this problem? Find out on page 12.

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