Apparatus for rotational motion

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complete and the helium allowed to escape. The volume of the balloon may be found either by displacement of water or by approximating the shape of a disk or an ellipsoid ($V_{\text{ellipsoid}} = 4/3 \pi a^2 b$).

Data

Typical data for this experiment:

$$a = 17.5 \text{ cm}$$

$$b = 8.5 \text{ cm}$$

$$V = 11,000 \text{ cm}^3$$

$$\rho_A = 1.20 \times 10^{-3} \text{ g/cm}^3$$

$$\rho_{He} = 0.18 \times 10^{-3} \text{ g/cm}^3$$

Mass of gondola and balloon = 12.60 g.

Our measurements for the buoyant force agreed with our calculations with a discrepancy of about 10%.

Reference

1. *Handbook of Chemistry and Physics*, 45th edition, edited by R.C. Weast (The Chemical Rubber Company, Cleveland, OH, 1964), pp. B-178 and F-8.

Apparatus for Rotational Motion

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A simple device for demonstration of rotational motion is shown in Fig. 1. Place a wooden bead on a 20-cm circular loop of copper wire (diameter 0.4 cm) which is brazed to a straight 5-cm handle. Insert the handle in a hand drill. As the drill starts to rotate, while the handle is oriented vertically, the bead

Fig. 1. Teaching tool for rotational motion.

moves up from the bottom position. The position of the bead on the loop depends on the angular velocity of the drill. Regardless of this velocity, however, the bead never crosses the horizontal mid-point on the loop. Relevant analysis follows.

Assuming the bead is free to move along the loop (i.e., negligible friction between the loop and the bead), the equations of motion along the radial and vertical directions are:

Fig. 2.

$$\Sigma F_n = m a_n \rightarrow N \sin \theta = R w^2 \sin \theta$$

$$\Sigma F_y = 0 \rightarrow mg - N \cos \theta = 0$$

Combining the above equations and solving for w , yields

$$w = \left(\frac{g}{R \cos \theta} \right)^{\frac{1}{2}}$$

Note: at $\theta = 90^\circ$, $w \rightarrow \infty$

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