Viscosity / Freefall Practical

Date

Method as per lab manual.

Ballbearing diameter / mm

2.990
2.995
2.990
2.995
2.995

Mean diameter 2.993 mm
± 0.003 mm
(0.1%)

Mean radius $R = 1.497$ mm
± 0.1%
(± 0.001 mm)

Mass of 30 ball bearings = 3.2g ± 0.1g
(3%)

Mass of 1 ball bearing = 0.11g ± 3% (A)
(± 0.003g)

Distance between markers $s = 27.5$ cm
± 0.2 cm
(0.7%)

Time to fall 5 cm / s

7.25
7.41
7.52
7.18
7.28
7.27

Mean $t = 7.32$ s

$\frac{1}{2}(7.52 - 7.18) = 0.17$ s

$t = 7.32$ s ± 0.17 s
(2.3%)

$$V = \frac{s}{t} = \frac{27.5 \times 10^{-2}}{7.32} = 0.0376 \text{ ms}^{-1}$$

$\pm 3\%$

Add percentage uncertainties ↑

$$F_d = mg = \left(\frac{3.2 \times 10^{-3}}{30}\right) \times 9.81 = 1.0 \times 10^{-3} \text{ N}$$

$\pm 3\%$ (A)

$$\eta = \frac{F_d}{6\pi R V} = \frac{1.0 \times 10^{-3}}{6 \times 3.14 \times 1.497 \times 10^{-3} \times 0.0376}$$

$$= \underline{0.94 \text{ Pa s}}$$

Summing all percentage uncertainties = 6.1%

$$\underline{\eta = 0.94 \text{ Pa s} \pm 0.06 \text{ Pa s}}$$

From the graph the % weight of glycerol is 98%.

The graph is too small to get an accurate figure for the uncertainty but it is approximately $\underline{\pm \frac{1}{3} \text{ of a } \%}$ by weight.

The graph scale could be reset to allow more accurate measurement.