

Solutions

Original-task allocations: B1 = one point, M1 = one method mark, A1 = one accuracy mark.

2.1 Accuracy concerns closeness to the true value. Precision concerns clustering of repeated values. A fixed zero offset can shift all closely clustered results away from the true value.

2.2 $d_{ind} = 3.5 + 18 \times 0.01 = 3.68$ mm. Subtract the positive zero error: $d = 3.68 - 0.02 = 3.66$ mm. Half resolution gives $\Delta d = 0.005$ mm, before considering other method uncertainties.

2.3 Half resolution: $\Delta m = 0.1/2 = 0.05$ g. Percentage = $(\Delta m/m) \times 100\%$. $0.05/84.6 \times 100 = 0.059\%$.

3.1 Mean $\bar{t} = (6.12 + 6.24 + 6.18 + 6.20)/4 = 6.185$ s. Half range $\Delta t = (6.24 - 6.12)/2 = 0.06$ s. Percentage = $0.06/6.185 \times 100 = 0.97\%$. The quoted mean has unjustified extra digits for the readings; 0.005 s uses half resolution but ignores the much larger repeat spread. Report about (6.19 ± 0.06) s.

3.2 $v = l/t = 0.080/0.040 = 2.0$ m s⁻¹. One speed is not a change in speed per time. Use two gates to find two passage speeds and measure the elapsed time between the corresponding speed positions/events, then $a = \Delta v/\Delta t$ for the stated mean acceleration.

3.3 Within-group clustering demonstrates precision/repeatability under the same method. Comparison across operators/apparatus examines reproducibility. A micrometer zero offset or different contact pressure could cause the discrepancy. Check both zeros/calibration or use a controlled ratchet technique on the same positions. A difference is evidence to investigate, not a reason to discard the inconvenient group without justification.