

Solutions

2.1

: average speed = travelled distance / elapsed time, $v_{\text{avg}} = d/t$: metre per second, written m/s or as a stacked fraction.

2.2

: $10.0/100 = 0.100$ m.: area = side² = $(0.100 \text{ m})^2 = 0.0100 \text{ m}^2$. The student's area happens to have the right numerical size but their stated side length does not support it.

2.3

: $v_{\text{avg}} = d/t$: $v_{\text{avg}} = 3.60/48.0 = 0.0750$ m/s.: three significant figures match the supplied values; leading zeros are not significant.

2.4

: readings are close, indicating good repeat precision for this record.: they differ substantially from the supplied 12.0 s reference.: therefore close repeats do not establish accuracy; a systematic timing problem should be investigated.

3.1

each: speed uses distance/time, not the reverse; inverted quotient has units s/m, not m/s; 10.0 cm is 0.100 m; area conversion squares the length factor; precision differs from accuracy; average speed does not establish constant speed. Accept justified reporting precision instead of one of the distinct unit corrections.

3.2

Local analytic rubric, 8 ×: state distance/time definition; give 0.0750 m/s; use appropriate precision; correct length conversion; square the conversion for area; distinguish close repeats from accuracy; use independent reference; avoid constant-speed or invented-uncertainty claim; coherent truthful 80–110 word response. Example: “Average speed is travelled distance divided by elapsed time. The trolley’s supplied values give 0.0750 metres per second, reported to three significant figures. This interval average does not prove constant speed. A side of 10.0 centimetres equals 0.100 metres, so its square area is 0.0100 square metres. Length and area need different conversion factors. The repeated timer readings are close together, but they disagree with the supplied 12.0-second reference. They therefore show repeat precision without establishing accuracy. We should investigate the timing procedure rather than add unsupported decimal places or invent an uncertainty range.”