

Straight-line motion with graphs and equations

AP Physics 1 (algebra-based) · Test answers (mark scheme)

The model answers give full working and a marking guide. Award method marks even when a numerical slip occurs, and allow any consistent sign convention. Do not penalise answers rounded to two significant figures when the data have two.

Level: AP Physics 1 (algebra-based) · **Curriculum:** AP P1 Unit 1

Question 1 Scalars and vectors (2 marks)

Scalar: speed (or distance). Vector: velocity (or acceleration). A scalar has size only, while a vector has size and direction.

Marking: 1 mark for a correct scalar and vector pair, 1 mark for the difference.

Question 2 Round trip (2 marks)

(a) Displacement = $300 - 120 = 180$ m east; average velocity = $180/150 = 1.2$ m/s east.

(b) Distance = 420 m; average speed = $420/150 = 2.8$ m/s.

Marking: 1 mark for part (a) with direction, 1 mark for part (b).

Question 3 Reading a graph (2 marks)

(a) $a = (10 - 0)/4 = 2.5$ m/s².

(b) Area = $\frac{1}{2} \times 4 \times 10 + 4 \times 10 = 20 + 40 = 60$ m.

Marking: 1 mark each part; accept the trapezium method.

Question 4 Using an equation (3 marks)

(a) $v^2 = v_0^2 + 2a\Delta x$: $a = (27^2 - 12^2)/(2 \times 90) = (729 - 144)/180 = 3.25$ m/s².

(b) $t = (27 - 12)/3.25 = 4.6$ s.

Marking: 1 mark for the equation, 1 mark for a, 1 mark for t.

Question 5 Stone into a canyon (3 marks)

(a) $\Delta y = \frac{1}{2}gt^2 = \frac{1}{2} \times 9.81 \times 3.0^2 = 44.1 \approx 44$ m.

(b) $v = gt = 9.81 \times 3.0 = 29$ m/s.

Marking: 1 mark for the equation, 1 mark for the depth, 1 mark for the speed.

Question 6 Interpreting a curve (2 marks)

The slope increases steadily, so the velocity increases uniformly: the object starts at rest and moves with constant positive acceleration. The velocity-time graph is a straight line through the origin with positive slope.

Marking: 1 mark for constant acceleration from rest, 1 mark for the straight-line v-t graph.

Question 7 Experimental design (3 marks)

Drop the ball from several measured heights h and time each fall at least three times, taking the mean. Plot h (vertical) against t^2 (horizontal). Since $h = \frac{1}{2}gt^2$, the graph is a straight line through the origin and **$g = 2 \times \text{slope}$** .

Marking: 1 mark for varying and measuring h and t with repeats, 1 mark for plotting h against t^2 , 1 mark for $g = 2 \times \text{gradient}$.

Question 8 Footbridge (3 marks)

(a) Taking down as positive, $\Delta y = v_0 t + \frac{1}{2}gt^2 = 6.0 \times 1.8 + \frac{1}{2} \times 9.81 \times 1.8^2 = 10.8 + 15.9 = 26.7 \approx \mathbf{27 \text{ m}}$.

(b) $v = 6.0 + 9.81 \times 1.8 = 6.0 + 17.7 = 23.7 \approx \mathbf{24 \text{ m/s}}$.

Marking: 1 mark for the equation, 1 mark for the height, 1 mark for the speed.