

Solutions

Each answer shows the steps, then the **result**.

2.1

- The time of flight (both motions happen over the same time)

2.2

- Zero – there is no horizontal force

2.3

- from rest with constant acceleration g , $v = u + at$ with $u = 0$:

$$v = gt = (10 \text{ m s}^{-2})(2 \text{ s})$$

- $v = \mathbf{20 \text{ m s}^{-1}}$ downwards

2.4

- the components are perpendicular, so use Pythagoras:

$$v = \sqrt{v_x^2 + v_y^2} = \sqrt{(6 \text{ m s}^{-1})^2 + (8 \text{ m s}^{-1})^2}$$

- $v = \mathbf{10 \text{ m s}^{-1}}$

3.1 C

- with no horizontal force, the horizontal velocity is constant

3.2 A

- the vertical motions are identical, so they land together

3.3

(a)

- vertically the ball starts with $v_y = 0$, so $h = \frac{1}{2}gt^2$; rearrange for t :

$$t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2(5 \text{ m})}{10 \text{ m s}^{-2}}}$$

- $t = \mathbf{1.0 \text{ s}}$

(b)

- horizontally the velocity is constant:

$$x = v_x t = (10 \text{ m s}^{-1})(1.0 \text{ s})$$

- $x = \mathbf{10 \text{ m}}$

3.4

(a)

- the components are perpendicular, so use Pythagoras:

$$v = \sqrt{v_x^2 + v_y^2} = \sqrt{(12 \text{ m s}^{-1})^2 + (5 \text{ m s}^{-1})^2}$$

- $v = \mathbf{13 \text{ m s}^{-1}}$

(b)

- angle from the components:

$$\theta = \tan^{-1} \frac{|v_y|}{v_x} = \tan^{-1} \frac{5}{12}$$

- $\theta = \mathbf{23^\circ}$ below the horizontal