

Vectors & Equations of Motion

1. (a) A vector has both a magnitude and a direction, and a scalar has a

magnitude

(b) **VECTOR:** displacement, velocity, acceleration, force, weight, momentum.

SCALAR: distance, speed, time, energy, mass.

2. MAGNITUDE

$$v^2 = 5^2 + 12^2 = 25 + 144 = 169$$

$$v = \sqrt{169} = 13\text{ms}^{-1}$$

ANGLE

$$\tan \vartheta = \frac{5}{12}$$

$$\vartheta = \tan^{-1}\left(\frac{5}{12}\right)$$

$$\vartheta = 22.6^\circ$$

FINAL ANSWER

The resultant velocity of the ferry is 13 ms^{-1} at 22.6° to the direction of the ferry (or 67.4° to the direction of the river).

(1 mark for the magnitude, 1 mark for the direction)

3. (a) Total distance travelled = $50\text{m} + 70\text{m} + 100\text{m} + 70\text{m} = 290 \text{ m}$. (1)

(b) Footballer's displacement at point D is 50 m West (or 270) (1)

(c)

$$\text{velocity} = \frac{\text{displacement}}{\text{time}} = \frac{50\text{mWest}}{50\text{s}}$$

$$\text{velocity} = 1\text{ms}^{-1} \text{ West (or 270)} \quad (2)$$

4. $u = ?$

$$v = ?$$

$$a = -9.8 \text{ ms}^{-2}$$

$$s = -2 \text{ m}$$

$$t = 0.6 \text{ s}$$

Choose $s = ut + \frac{1}{2}at^2$ (1/2)
and substitute known values

$$-2 = 0.6u - 4.9 \times 0.36 \quad (1/2)$$

rearrange to solve for **u**

$$u = 0.39 \text{ ms}^{-1} \quad (1)$$

5.(a) $v_x = 20 \cos 30 = 17.3 \text{ ms}^{-1}$ (1)

$$v_y = 20 \sin 30 = 10 \text{ ms}^{-1} \quad (1)$$

(b) $u = 10 \text{ ms}^{-1}$ $v^2 = u^2 + 2as$ (1/2)

$$v = 0 \text{ ms}^{-1}$$

$$a = -9.8 \text{ ms}^{-2} \quad 0 = 100 - 19.6s \quad (1/2)$$

$$s = ?$$

$$t = \quad s = 5.1 \text{ m} \quad (1)$$

(c) **VERTICAL**

$$u = 10 \text{ ms}^{-1}$$

$$v =$$

$$a = -9.8 \text{ ms}^{-2}$$

$$s = 0 \text{ m}$$

$$t =$$

HORIZONTAL

$$v = 17.3 \text{ ms}^{-1}$$

$$s = ?$$

$$t =$$

For time, use vertical motion.

$$s = ut + \frac{1}{2}at^2 \quad (1/2)$$

$$t = 2.04 \text{ s} \quad (1)$$

For range, use horizontal motion

$$s = vt \quad (1/2)$$

$$s = 35.3 \text{ m} \quad (1)$$

(d) There would be air resistance, which would reduce the horizontal speed. (1)