2018 Ph H2 Q1

Section: Our Dynamic Universe

Topic: Projectiles

Question Summary

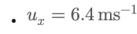
A sponge is thrown at 7.4 m s⁻¹, at an angle of 30° to the horizontal, from a height of 1.5 m. We calculate:

Horizontal and vertical velocity components.

The height at which it hits the teacher.

- 2. Time to reach maximum height.
- 4. Why throwing it faster at the same angle does not reduce the
- time.

(a)(i) Horizontal and vertical components



Answer:

- $u_y = 3.7 \,\mathrm{ms}^{-1}$
- Working:

 $u_y = u \sin \theta = 7.4 \sin 30 = 3.7 \,\mathrm{ms}^{-1}.$

 $u_x = u\cos\theta = 7.4\cos 30 = 6.4\,\mathrm{ms}^{-1},$

Answer:

(a) (ii) Time to maximum height

Working:

 $t = 0.38 \, \mathrm{s}$

At the top v=0: $v = u_y + at$

 $0 = 3.7 - 9.8t \Rightarrow t = 0.38 \,\mathrm{s}.$

(a)(iii) Height at which it hits the teacher

$h = 1.2 \, \text{m}$

Answer:

Working:

launch.

The sponge takes 0.38 s up and 0.45 s down, total 0.83 s from

 $s = u_y t + \frac{1}{2}at^2,$

Vertical displacement:

 $s = 3.7(0.83) + 0.5(-9.8)(0.83^2) = 3.07 - 3.35 = -0.28 \,\mathrm{m}.$

Height above ground:

 $h = 1.5 + s = 1.5 - 0.28 = 1.2 \,\mathrm{m}.$

(b) Explanation

The vertical motion (and therefore time in air) depends only on

Answer:

vertical velocity and height, not the horizontal velocity. A faster throw at the same angle does not change the vertical motion time, so the total flight time is unchanged.

Quick Tips

- · Split initial velocity into horizontal and vertical components first.
- · Vertical motion is independent of horizontal motion.
- Use v = u + at for times and $s = ut + \frac{1}{2}at^2$ for heights.