OCR A A Level Projectile Motion worksheet

35-40 minutes independent practice + 15-20 minutes review

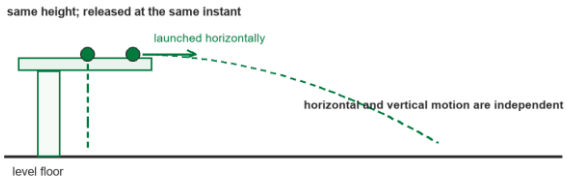
Specification points covered

• 3.1.2(a)(i) Apply equations of motion for constant acceleration in a straight line, including motion in a uniform gravitational field without air resistance.
• 3.1.3(a) Understand independence of vertical and horizontal motion of a projectile.
• 3.1.3(b) Analyse two-dimensional motion of a projectile with constant velocity in one direction and constant acceleration in a perpendicular direction.

Use throughout

Take g = 9.81 m s^{-2}. Ignore air resistance unless a question states otherwise.
Treat the horizontal and vertical motions separately. A component of velocity can increase, decrease or stay the same; do not write that a velocity 'accelerates'.

1. Independent horizontal and vertical motion



1. For a projectile moving through the air with air resistance ignored, state its horizontal acceleration. [1 mark]

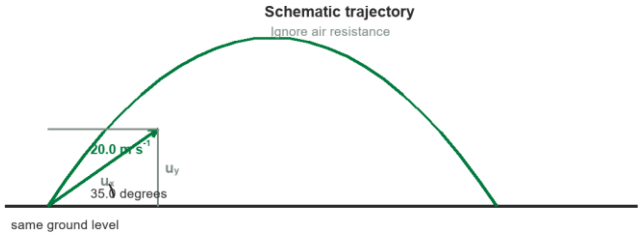
2. For the same projectile, state its vertical acceleration. Include a direction. [1 mark]

3. Two identical marker balls are released from the same height at the same instant. One is dropped and the other is launched horizontally. Explain why they reach the level floor at the same time, ignoring air resistance. [2 marks]

2. Launching a survey marker at an angle

Context

A lightweight survey marker is launched from ground level at 20.0 m s^{-1} at an angle of 35.0 degrees above the horizontal. It returns to the same ground level.



4. Calculate the initial horizontal component u_x and initial vertical component u_y of the marker's velocity. [2 marks]

5. Calculate the time taken for the marker to reach its maximum height. [1 mark]

6. Calculate the maximum height of the marker above the launch point. [2 marks]

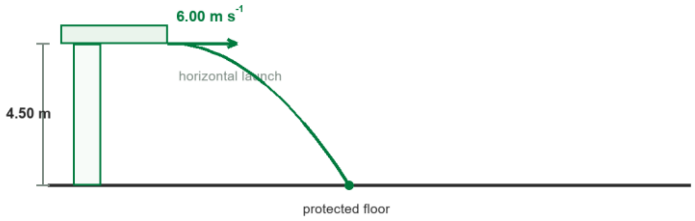
7. Calculate the total time for which the marker is in the air. [1 mark]

8. Calculate the horizontal range of the marker. [2 marks]

3. Horizontal launch: foam capsule

Context

A foam capsule leaves a horizontal launcher 4.50 m above a protected floor with a horizontal speed of 6.00 m s^{-1}.



9. Calculate the time taken for the foam capsule to reach the protected floor. [2 marks]

10. Calculate the horizontal displacement of the foam capsule before it reaches the protected floor. [1 mark]

11. Calculate the vertical component of velocity of the foam capsule immediately before impact. Include a direction. [1 mark]

12. Calculate the resultant speed of the foam capsule immediately before impact. [2 marks]

13. Calculate the direction of the foam capsule's velocity immediately before impact, measured below the horizontal. [1 mark]

4. Applying the model

Before you answer

Use the words 'horizontal component' and 'vertical component' precisely. Remember: the two components are independent.

14. A pupil says, 'the horizontal velocity gradually changes into vertical velocity'. Explain why this is not a correct description of the projectile's motion. State how each component changes. [2 marks]

15. A second identical foam capsule is launched horizontally from the same height at 12.0 m s^{-1} instead of 6.00 m s^{-1}. Compare its time in the air and horizontal displacement with those of the first capsule. Explain your answer. [2 marks]

16. A sports-engineering team wants to test whether horizontal displacement x is proportional to launch speed u for a foam ball launched horizontally from a fixed height. Describe a safe method, including measurements, control variables, repeats and how the data should be analysed. [4 marks]

Review and improve

- □ I can resolve a launch velocity into horizontal and vertical components.
- □ I can use separate horizontal and vertical calculations for a projectile.
- □ I can describe component motion using precise scientific language.