

Lesson 6

A-Level Applied Mathematics : Mechanics : Year 2 Projectiles (Kinematics III)

6.1 Twin Launch With Time Delay

Example

A small boy lets go of a helium filled balloon at the base of a 70 metre high tower. It was 2 metres above the ground when released.

The balloon accelerates upwards at a constant rate of 2 m s^{-2}

A stone, from rest, is dropped from the top of the tower 0.5 seconds later.

The balloon and the stone collide.

(i) How long after the balloon was released does the collision occur ?

[8 marks]

(ii) At what height above the ground does the collision occur ?

[2 marks]

6.2 Exercise

Any solution based entirely on graphical or numerical methods is not acceptable

Marks Available : 32

Question 1



A stone, at rest, is dropped from the top of the 55.86 metre tall leaning tower of Pisa. A second later, a second stone is thrown at after the first, vertically downward with an initial speed of 12 m s^{-1} (That's about 27 mph)
At what height above the ground might the two stones collide ?

[10 marks]

Question 2

A dog biscuit is projected at an angle of 34° with speed 12 m s^{-1} from a height of 1.5 metres above a level area of grassland.

A small dog, 14 metres away, launches vertically upward to catch the biscuit as it passes overhead. The dog catches the biscuit as the dog reaches its maximum height.

- (i) How many seconds after the biscuit was thrown should the dog be at its maximum height ?

[2 marks]

- (ii) How high is the biscuit above the ground at this time ?

[4 marks]

- (iii) How long after the biscuit is thrown should the dog launch ?

[4 marks]

- (iv) State two assumptions made, other than air resistance, in modelling the situation described using the *suvat* equations.

[2 marks]

Question 3

A bullet is fired at 140 m s^{-1} with an angle of elevation of 30° .

At a horizontal distance away of 1700 metres, is a 50 metre high pole.

As a part of a magic trick, a target is to be dropped from the top of the pole such that the target "catches the bullet".

How many seconds after the bullet is launched must the target, falling under gravity, be dropped ?

Assume the pole, down which the target falls, is frictionless.

[10 marks]

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