

Lesson 4

Constant Acceleration Kinematics Applied Mathematics (Mechanics) Year 1

4.1 Vertical Launch Kinematics #2

Here is an interesting old examination question with the potential to confuse;

At time $t = 0$, a particle is projected vertically upwards from a point 10 m above the ground. The particle hits the ground with speed 17.5 ms^{-1}

(a) With what speed was the particle launched ?

[3 marks]

(b) What is the time of flight ?

[4 marks]

4.2 Exercise

Question 1

M1 Examination Question, May 2003, Q2

A competitor makes a dive from a high springboard into a diving pool.

She leaves the springboard vertically with a speed of 4 ms^{-1} upwards.

When she leaves the springboard, she is 5 m above the surface of the pool.

The diver is modelled as a particle moving vertically under gravity alone and it is assumed that she does not hit the springboard as she descends.

- (a) Find her speed when she reaches the surface of the pool

[3 marks]

- (b) Find the time taken to reach the surface of the pool

[3 marks]

- (c) State two physical factors which have been ignored in the model

[2 marks]

Question 2

M1 Examination Question, January 2007, Q2

A ball is projected vertically upwards with speed 21 ms^{-1} from a point A which is 1.5 m above the ground. After projection, the ball moves freely under gravity until it reaches the ground. Modelling the ball as a particle, find

(a) the greatest height above A reached by the ball

[3 marks]

(b) the speed of the ball as it reaches the ground

[2 marks]

(c) the time between the instant when the ball is projected from A and the instant when the ball reaches the ground

[4 marks]

Question 3

M1 Examination Question, May 2010, Q6

A ball is projected vertically upwards with a speed of 14.7 ms^{-1} from a point which is 49 m above horizontal ground. Modelling the ball as a particle moving freely under gravity, find

(a) the greatest height, above the ground, reached by the ball

[4 marks]

(b) the speed with which the ball first strikes the ground

[3 marks]

(c) the total time from when the ball is projected to when it first strikes the ground

[3 marks]

Question 4

M1 Examination Question, January 2008, Q2

A firework rocket starts from rest at ground level and moves vertically.

In the first 3 s of its motion, the rocket rises 27 m.

The rocket is modelled as a particle moving with constant acceleration $a \text{ ms}^{-2}$

Find

(a) the value of a

[2 marks]

(b) the speed of the rocket 3 s after it has left the ground

[2 marks]

After 3 s, the rocket burns out. The motion of the rocket is now modelled as that of a particle moving freely under gravity

(c) Find the height of the rocket above the ground 5 s after it has left the ground

[4 marks]

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