

Equations for Motion with Constant Acceleration

1 A police car accelerates from 15 m s^{-1} to 35 m s^{-1} in 5 seconds. The acceleration is constant.

- (a) Calculate the acceleration of the police car.
 - (b) Work out the distance travelled by the police car during this time.
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2 A marathon competitor running at 5 m s^{-1} puts on a sprint when she is 100 metres from the finish, and covers this distance in 16 seconds. Assuming that her acceleration is constant,

- (a) calculate her speed as she crosses the finish line.
 - (b) calculate her acceleration.
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3 A train travelling at 20 m s^{-1} starts to accelerate with constant acceleration. It covers the next kilometre in 25 seconds.

- (a) Find the speed of the train at the end of the 25 seconds.
 - (b) Calculate the acceleration of the train during the 25 seconds.
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4 A long-jumper takes a run of 30 metres to accelerate to a speed of 10 m s^{-1} from a standing start.

- (a) Work out his acceleration during this period.
 - (b) Find the time it takes him to run the 30 m.
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Questions on Vertical Motion (Free Fall) under Gravity

5. A stone is dropped from the top of a tower of height 100m. Assume that there is no air resistance.

- (a) Work out the speed with which the stone hits the ground.
- (b) How long does it take the stone to fall to the ground?

6. A parcel is dropped from a helicopter hovering in the air.

The parcel travels vertically downwards and hits the ground with a speed of 70 m/s.

At what height above the ground is the helicopter hovering in? You may assume that there is no air resistance.

7. A stone is thrown vertically upwards with a speed of 15 m/s.

Assuming no air resistance, calculate the maximum height reached by the stone.

8. An arrow fired vertically upwards from ground level reaches a maximum height of 20m.

How fast should the arrow have left the bow to reach this height?

You may assume that there is no air resistance against the motion of the arrow.

9. A ball is thrown vertically upwards from the top of a tower of height 140 m. The initial upward velocity of the stone is 25 ms^{-1} .

Find,

- (a) the maximum height, above the ground, reached by the ball.
 - (b) the time of flight of the ball.
 - (c) The velocity with which the ball hits the ground.
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10. A stone is thrown vertically upwards from the ground with an initial velocity of 20 ms^{-1} . How long will it take to return to the ground? What would be the velocity with which it hits the ground?
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11. An object is thrown vertically upwards from the top of a tower of height 200 m. After a while it reaches the ground with a speed of 100 ms^{-1} . Find the initial velocity of the object. What is the time of flight?
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12. A stone is thrown vertically upwards from the top of a tower of height 100 m. It reaches the ground after 8 seconds. Find the initial velocity of the object and the velocity with which it hits the ground