You will *not* be expected to recall the formula linking initial and final velocities, acceleration and distance in your examination. However you will be expected to be able to change the subject of the formula and to use the correct units.

The following formula links initial and final velocities, acceleration and distance travelled (x).

$$v^2 - u^2 = 2 \times a \times x$$

1 A car travels 100 m as it accelerates from rest to 25 m/s. Calculate its acceleration.

2 A car accelerates from 10 m/s to 20 m/s over a distance of 80 m. Calculate its acceleration.

3 A cyclist comes to a stop from a velocity of 15 m/s. The acceleration is –3 m/s^2. How far does the bicycle travel while it is braking?

4 A rocket is launched with an acceleration of 35 m/s^2. How far has it travelled when it reaches a velocity of 700 m/s?

5 A car is travelling at 10 m/s. It accelerates to 35 m/s over a distance of 225 m. Calculate the acceleration.

6 The driver of a car travelling at 10 m/s brakes hard and brings the car to a stop over a distance of 10 m.

a Calculate the deceleration of the car.

b How far would the car travel while braking to a stop from 20 m/s, if the deceleration was the same?

7 An oil tanker is sailing at 8 m/s. It takes 3 km to come to a stop. Calculate the deceleration.

8 A bullet leaves a musket (an old type of gun) with a velocity of 150 m/s. The barrel of the musket is 115 cm long. Calculate the acceleration of the bullet as it leaves the barrel.

9 A rifle has a barrel 80 cm long. The bullet leaves the barrel at a velocity of 800 m/s. Calculate the acceleration of the bullet as it leaves the barrel.

10 Calculate the final velocities of the following vehicles.

a A car that accelerates from rest at 3 m/s^2 over a distance of 100 m.

b A car that accelerates from an initial velocity of 10 m/s over a distance of 150 m. The acceleration is 2 m/s^2.

c A car that brakes from 15 m/s over a distance of 20 m. The acceleration is –4 m/s^2.

11 A spacecraft is moving at 15 km/s when its engine is fired for 15 minutes. The engine provides an acceleration of 0.003 m/s^2. During this time the spacecraft travels 15 000 km. Calculate its final velocity.

12 Calculate the initial velocities for these vehicles:

a a car that accelerates at 2 m/s^2 over a distance of 50 m to reach a velocity of 20 m/s.

b a car that brakes to provide a deceleration of –3 m/s^2, and comes to a halt over a distance of 40 m.

c a bicycle that accelerates at 0.5 m/s^2 over a distance of 10 m to reach a velocity of 8 m/s.

13 A boy is sliding on ice. Once he is on the ice he decelerates at –2 m/s^2 and comes to a stop after sliding for 6 m. How fast was he running just before he started sliding?

14 An airliner takes 2 km to come to a stop when it lands. If it decelerates at –1.4 m/s^2 once it touches down, calculate its velocity just before touch-down.

15 A car is travelling at 30 m/s. The driver brakes hard when she sees an obstacle in the road. If the deceleration of the car is –6 m/s^2 and the obstacle is 60 m away when she applies the brakes, show that she will hit the wall.

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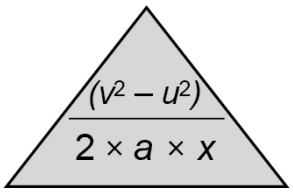
Hint for questions 1 to 9



v = final velocity (m/s)

u = initial velocity (m/s)

a = acceleration (m/s^2)

x = distance (m)

(final velocity)^2 – (initial velocity)^2 = 2 × acceleration × distance

$v^2 - u^2 = 2 \times a \times x$

Hint for questions 10 to 15

To calculate v:

$v^2 - u^2 = 2 \times a \times x$ (+ u^2 / + u^2)

$v^2 = 2 \times a \times x + u^2$

When you have found v^2, take the square root to find v.

To calculate u:

$v^2 - u^2 = 2 \times a \times x$ (- v^2 / - v^2)

$-u^2 = 2 \times a \times x - v^2$ (x (-1) / x (-1))

$u^2 = v^2 - (2 \times a \times x)$

When you have found u^2, take the square root to find u.