Acceleration

**Useful Equation:**

a

v –u

t

a

=

t

v - u

where: a is the acceleration of an object (m/s2)

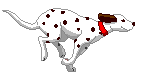
v is the final velocity of an object (m/s)

u is the initial velocity of an object (m/s)

t is the time that an object accelerates for (s)

1. Copy and complete this table .

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|  | ***Acceleration* / m/s2** | ***Change in Speed* / m/s** | ***Time /* s** |
| **(a)** |  | 12 | 6 |
| **(b)** |  | 16.5 | 5.5 |
| **(c)** | 0.5 |  | 18 |
| **(d)** | 1.2 |  | 30 |
| **(e)** | 0.125 | 0.50 |  |
| **(f)** | 2.70 | 11.34 |  |

1. What is the magnitude of the acceleration of a dog that starts from rest and reaches a speed of 4.0 metres per second in 2.0 seconds?
2. What is the size of the acceleration of a car that speeds up from 3 metres per second to 15 m/s in 7.5 seconds?



1. A motorbike accelerates at a rate of 0.8 m/s2. How long will it take for the motorbike to increase in speed by 18 m/s?
2. What is the final speed of a sprinter who starts at rest and accelerates at 2.2 m/s2 for 4.5 seconds?



1. What was the initial speed of a horse that reaches a speed of 12.3 m/s after accelerating at a rate of 3.8 m/s2 for 2.5 seconds?
2. A car is travelling at 9.0 m/s when a cat runs out on to the road. The driver applies the brakes and comes to a stop 0.6 seconds later. What is the magnitude of the deceleration of the car during this time?
3. An aeroplane accelerates from 360 km/h to 396 km/h in 1 minute and 40 seconds. What is the size of the acceleration of the aeroplane in m/s2?

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| **Acceleration** | |
| **3.1** | **I can define acceleration as the final velocity subtract the initial velocity divided by the time for the change** |
| 3.1.1 | State the meaning of the term “acceleration”. |
| 3.1.2 | Explain what is meant by a *uniform acceleration of 1.4 ms-2* |
| **3.2** | **I can use the relationship involving acceleration, change in speed and time**  **(a = ∆v/t).** |
| 3.2.1 | A Jaguar can reach 27 ms-1 from rest in 9.0 s, calculate its acceleration. |
| 3.2.2 | The space shuttle reached 1000 ms-1, 45 s after launch, calculate its acceleration. |
| 3.2.3 | Starting from rest, a flea accelerates to 1·2 ms-1 in a time of 0·001 s. Calculate the acceleration of the flea. |
| 3.2.4 | A car reaches a velocity of 30 ms-1 from a velocity of 18 ms-1 in 6 s. Calculate its acceleration. |
| 3.2.5 | A train moving at 10 ms-1 increases its speed to 45 ms-1 in 10 s. Calculate its acceleration. |
| 3.2.6 | A bullet travelling at 240 ms-1 hits a wall and stops in 0.2 s. Calculate its acceleration. |
| 3.2.7 | A car travelling at 20 ms-1 brakes and slows to a halt in 8 s. Calculate its acceleration. |
| **3.3** | **I can use appropriate relationships to solve problems involving acceleration, initial velocity (or speed) final velocity (or speed) and time of change.** |
| 3.3.1 | State the formula linking velocity and acceleration. Explain what each letter stands for and the units of each. |
| 3.3.2 | A girl is riding a bicycle. She starts at rest, and accelerates to 20 ms-1 in 8.0 seconds, calculate her acceleration. |
| 3.3.3 | A car increases its velocity from 30 ms-1 to 80 ms-1 in 20 seconds. Calculate its acceleration. |
| 3.3.4 | When you drop a stone, it accelerates downwards at 9.8 ms-2.  If the stone is initially at rest, calculate its speed after falling for 1.5 seconds. |
| 3.3.5 | A racing car can accelerate at 7 ms-2, calculate the time taken to increase its velocity from 20 ms-1 to 60 ms-1. |

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| 3.3.6 | A rocket in orbit accelerates at 12 ms-2 for 15 seconds. If its final velocity is 300 ms -1, calculate its initial velocity. |
| 3.3.7 | On approaching the speed limit signs, a car slows from 30 m/s to 12 m/s in 5 s. Calculate its acceleration. |
| 3.3.8 | A bowling ball is accelerated from rest at 3 ms-2 for 1.2 s, calculate the final speed it will reach. |
| 3.3.9 | Calculate the time it takes a car to increase its speed from 8 ms-1 to 20 ms-1 if it accelerates at 3 ms-2. |
| 3.3.10 | A cyclist can accelerate at 0.5 ms-2 when cycling at 4 ms-1. Calculate the time taken to reach 5.5 ms-1. |
| 3.3.11 | The maximum deceleration a car’s brakes can safely produce is 8 ms-2, this is an acceleration of -8 ms-2  Calculate the minimum stopping time if the driver applies the brakes when travelling at 60 mph (27 ms-1). |
| 3.3.12 | A car is stationary at a traffic light. When the light turns green the car accelerates, and reaches a speed of 30mph twenty seconds later.  (i) State the car’s initial velocity.  (ii) Calculate the car’s acceleration in miles per hour per second. |