Lesson 6

GCSE Mathematics
Kinematics

6.1 Acceleration

A motorbike accelerates from a speed of $4ms^{-1}$ at a constant rate of $1.5ms^{-2}$

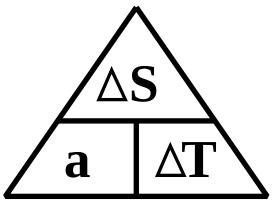
After 1 second its change in speed is : ∴ speed =

After 2 seconds its change in speed is : ∴ speed =

After 3 seconds its change in speed is : ∴ speed =

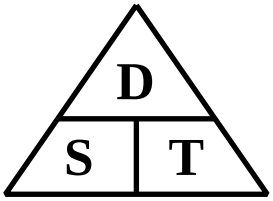
After 4 seconds its change in speed is : ∴ speed =

After *t* seconds its change in speed is : ∴ speed =



6.2 Formulae for constant acceleration

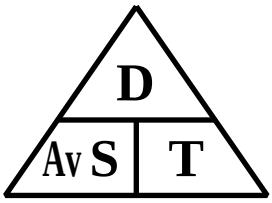
TRUE FOR ZERO ACCELERATION



$$Distance = Speed \times Time$$

TRUE FOR ZERO ACCELERATION

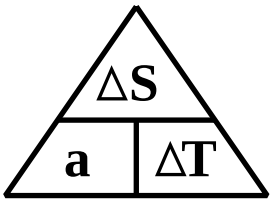
TRUE FOR CONSTANT NON-ZERO ACCELERATION



$$Distance = Average\ Speed \times Time$$

TRUE FOR CONSTANT NON-ZERO ACCELERATION

TRUE FOR CONSTANT NON-ZERO ACCELERATION



$$acceleration = \frac{change\ in\ Speed}{change\ in\ Time}$$

TRUE FOR CONSTANT NON-ZERO ACCELERATION

6.3 Example

A motorbike accelerates uniformly from 6 ms^{-1} to 24 ms^{-1} in 3 seconds.

(i) What is the motorbike's change in speed ?

(ii) What is its rate of acceleration ?

6.4 Exercise

Question 1

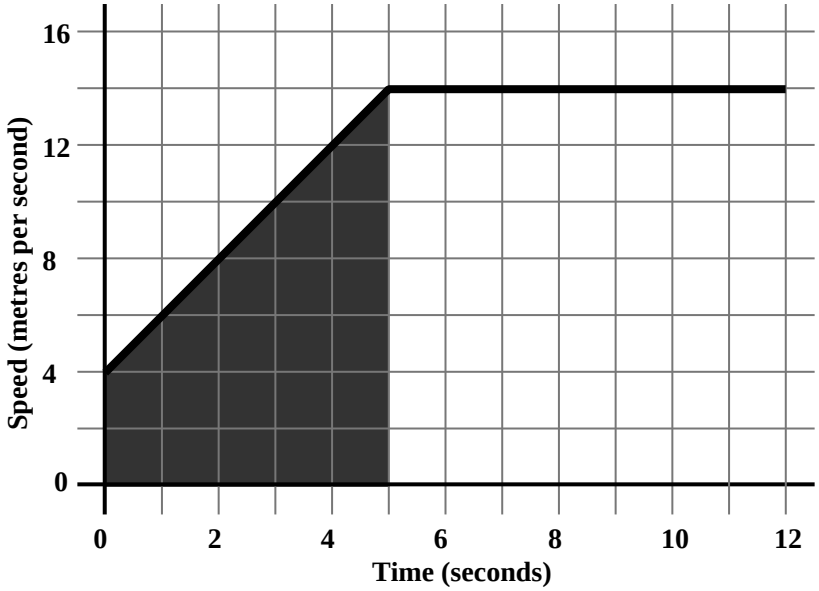
A motorbike accelerates uniformly from 5m/s to 14m/s in 3 seconds.

(i) What is the motorbike's change in speed ?

(ii) What is its rate of acceleration ?

Question 2

The Speed-Time graph shows a car accelerating for 5 seconds, then moving at a constant speed (with zero acceleration).



(i) What is the car's speed when $t = 0$ seconds ?

(ii) What is the car's speed when $t = 5$ seconds ?

(iii) What is the change in speed between $t = 0$ and $t = 5$?

(iv) Calculate the rate of acceleration over the five seconds.

HINT : $a = \frac{\Delta S}{\Delta T}$

(v) Calculate the area shaded, which is the distance travelled whilst accelerating.

Question 3

A pushbike accelerates uniformly from 2.5m/s to 7.5m/s in 10 seconds.

(i) What is the pushbike's change in speed ?

(ii) What is its rate of acceleration ?

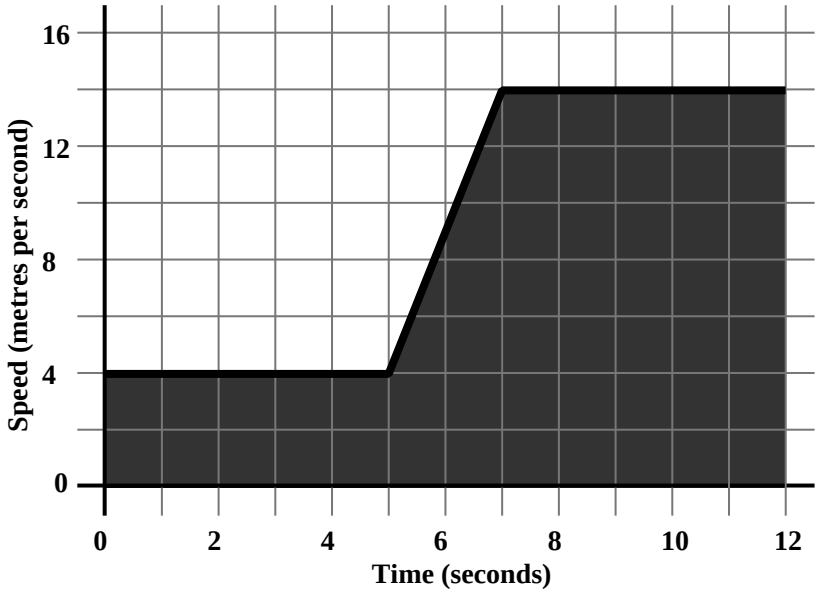
Question 4

A truck accelerates uniformly from 3m/s to 17m/s in 7 seconds.

(i) What is the truck's change in speed ?

(ii) What is its rate of acceleration ?

Question 5



A car's speed over a twelve second period is given by the Speed - Time graph.

(i) Between which two times was the car accelerating ?

(ii) Calculate the rate of acceleration.

(iii) Calculate the total distance travelled by the car over the twelve seconds.

Question 6

A sports car accelerates at $3m/s^2$ for 4 seconds.

(i) What is its change in speed ?

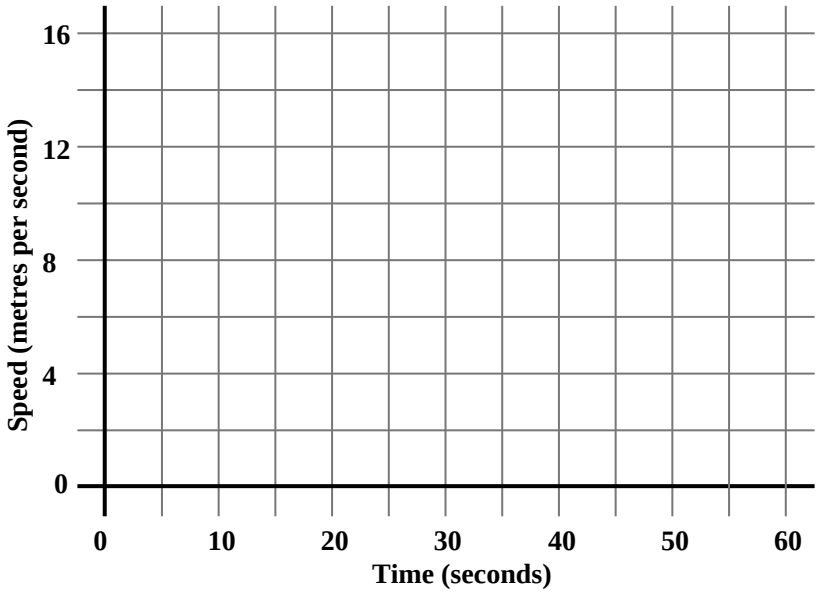
HINT : $\triangle S = a \times \triangle T$

The sports car was moving at 8m/s at the start of the acceleration.

(ii) What was its speed at the end of the acceleration ?

Question 7

A car is moving at a constant speed of 6m/s between $t = 0$ and $t = 10$ seconds.
Then, over 40 seconds, it accelerates uniformly to a speed of 16m/s.
It then moves at a constant speed of 16m/s for 10 seconds.



(i) Draw the Speed - Time graph for the car movements described.

(ii) What is the rate of acceleration between $t = 0$ and $t = 10$?

(iii) What is the rate of acceleration between $t = 10$ and $t = 50$?

(iv) What is the rate of acceleration between $t = 50$ and $t = 60$?

(v) Calculate the distance travelled over the 60 seconds.

Question 8

A bus accelerates at $0.5 m/s^2$ for 24 seconds.

(i) What is its change in speed ?

HINT : $\triangle S = a \times \triangle T$

The bus was moving at 5.5m/s at the start of the acceleration.

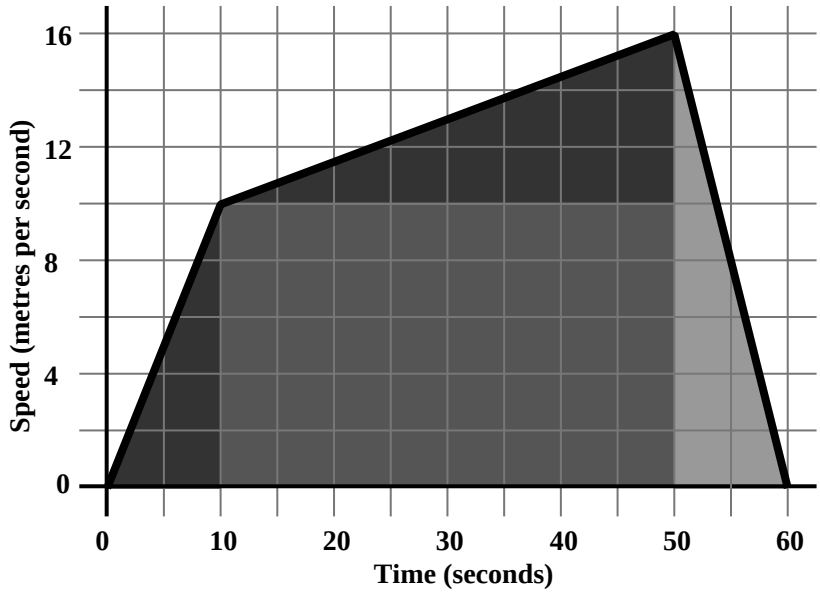
(ii) What was its speed at the end of the acceleration ?

Question 9

How long will it take a car, accelerating uniformly at $2 m/s^2$ to increase its speed from 3m/s to 21m/s ?

HINT : $\triangle T = \frac{\triangle S}{a}$

Question 10



Calculate the rate of acceleration between;

(i) $t = 0$ and $t = 10$

(ii) $t = 10$ and $t = 50$

(iii) $t = 50$ and $t = 60$

Question 11

A car can slow down at a rate of $5 m/s^2$.

(a) It is travelling at 10m/s. (About 22mph)

(i) How many seconds will it take to stop ?

HINT : $\Delta T = \frac{\Delta S}{a}$

(ii) How far will it move in that time ?

HINT : $D = Av\ S \times T$

(b) It is travelling at 20 m/s. (About 45mph)

(i) How many seconds will it take to stop ?

(ii) How far will it move in that time ?

(c) It is travelling at 30 m/s. (About 67mph)

(i) How many seconds will it take to stop ?

(ii) How far will it move in that time ?

(d) It is travelling at 40 m/s. (About 90mph)

(i) How many seconds will it take to stop ?

(ii) How far will it move in that time ?

(e) Put your part **(a)**, **(b)**, **(c)** and **(d)** answers into the table;

speed m/s (mph)	10 (22)	20 (45)	30 (67)	40 (90)
time to stop seconds				
distance to stop metres				

(f) Comment :