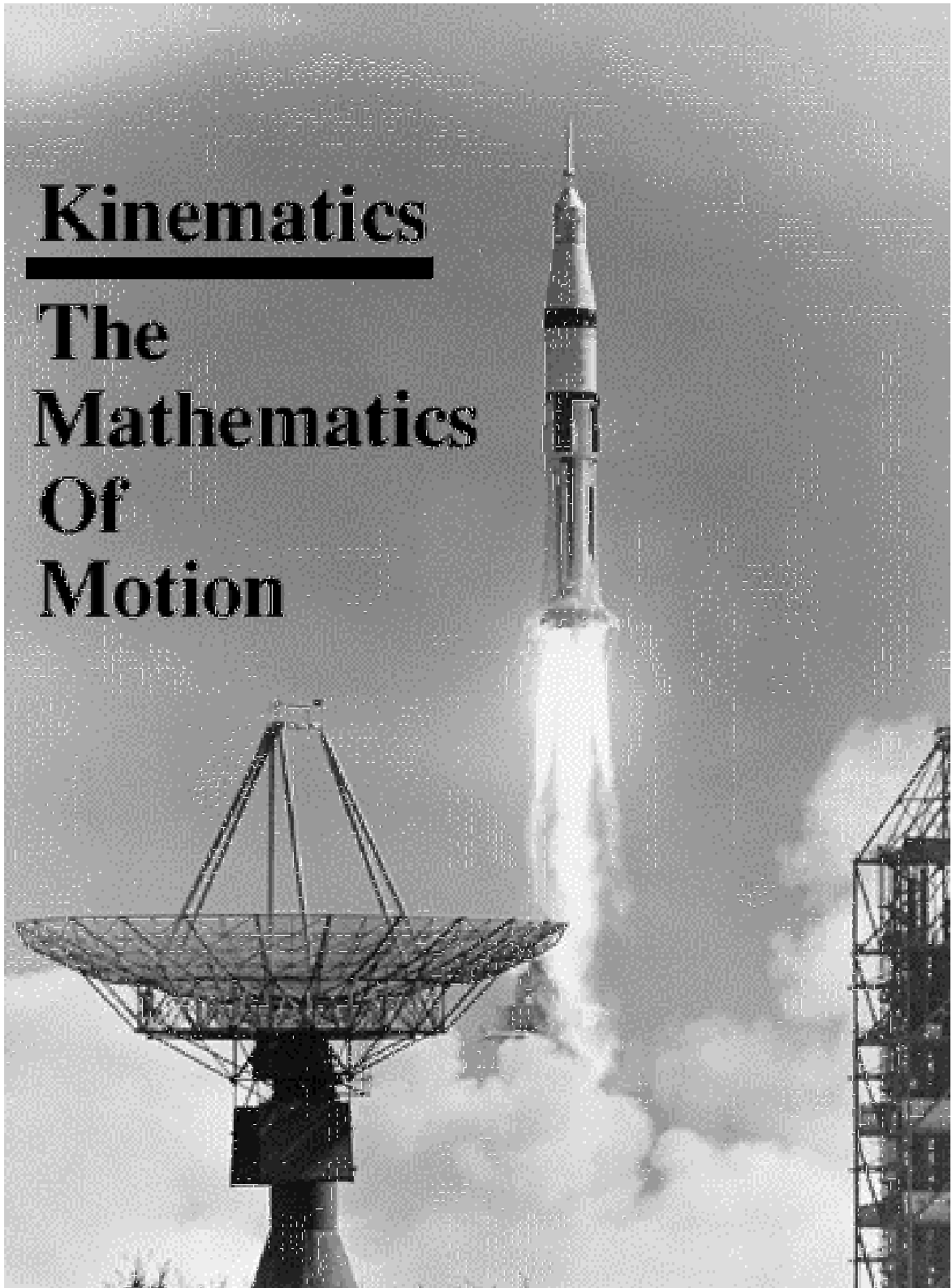


Kinematics

The Mathematics Of Motion



Apollo 7 lifts off from Cape Canaveral, Florida, with a crew of three on board, on October 11th 1968. Less than two years later, Apollo 11 landed the first humans on Earth's Moon. Five additional Apollo missions landed on the Moon between 1969 and 1972. No humans have been back to the Moon since.

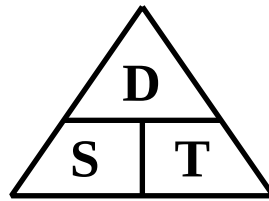
Kinematics

The Mathematics Of Motion

GCSE Mathematics
Kinematics

Lesson 1

1.1 The *Distance, Speed, Time* formula Triangle



$$\text{Distance} = \text{Speed} \times \text{Time}$$

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

These formulae are only true when the speed is constant.

i.e. When there is ZERO acceleration.

Distance is measured in metres, speed in metres per second, and time in seconds.

1.2 Example

A jogger travels at a constant speed of 3m/s for 6 minutes.

(i) How many seconds are in 6 minutes ?

(ii) How far does the jogger travel ?

(iii) Is this more or less than 1 km ?

1.3 Exercise

Question 1

Write these times in seconds.

- (i) 4 minutes.
- (ii) 1 hour.
- (iii) 2 $\frac{1}{2}$ minutes.
- (iv) half an hour.

Question 2

Write these distances in metres.

- (i) 4 km.
- (ii) $\frac{1}{2}$ km.
- (iii) 0.7 km.
- (iv) 1 $\frac{3}{4}$ km.

Question 3

A jogger travels at a constant speed of 4m/s for 4 minutes.

- (i) How many seconds are in 4 minutes ?
- (ii) How far does the jogger travel ?
- (iii) Is this more or less than 1 km ?

HINT : $D = S \times T$

Question 4

A walker travels at a constant speed of 1.5m/s for 11 minutes.

(i) How many seconds are in 11 minutes ?

(ii) How far does the walker travel ?

(iii) Is this more or less than 1 km ?

Question 5

A man leaves his house at 1:15pm.

He jogs at a constant speed of 2m/s returning home at 1:35pm.

(i) For how long did the man jog ?
Give your answer in seconds.

(ii) How far did the man travel ?
Give your answer in metres.

(iii) Change your part (ii) answer into km.

Question 6

A man runs 6 km at a steady speed in 40 minutes.

(i) How many metres is 6 km ?

(ii) How many seconds are in 40 minutes ?

(iii) Find the man's speed in m/s.

$$\text{HINT : } S = \frac{D}{T}$$

Question 7

A jogger runs $\frac{3}{4}$ km at a steady speed in 6 minutes and 15 seconds.

- (i) How many metres is $\frac{3}{4}$ km ?
- (ii) How many seconds are in 6 minutes and 15 seconds ?
- (iii) Find the jogger's speed in m/s.

Question 8

A car travels 21 km at a constant speed of 25m/s.

- (i) Write 21 km in metres.
- (ii) How long does the car take to travel the 21 km ?
Give your answer in seconds.

HINT : $T = \frac{D}{S}$

- (iii) How many minutes is this ?

Question 9

Here is a formula to convert speeds in km/h into speeds in m/s;

$$Speed\ in\ m/s = \frac{5}{18} \times Speed\ in\ km/h$$

Use this formula to convert the following km/h speeds into m/s speeds.

- (i) 54 km/h
- (ii) 90 km/h
- (iii) 45 km/h

Question 10

A car travels at a constant speed of 72 km/h for 6 km.

- (i) How many m/s is 72 km/h ?

HINT : Use the Question 9 formula

- (ii) How many metres is 6 km ?

- (iii) How long does the car take to travel the 6 km ?
Give your answer in seconds.

- (iv) How many minutes is this ?

Question 11

UK road speed signs are in miles per hour (mph).

Here is a formula to convert speeds in m/s into speeds in mph;

$$\text{Speed in mph} = 2.237 \times \text{Speed in m/s}$$

- (a) Use this formula to convert the following m/s speeds into mph speeds.

- (i) 1 m/s

- (ii) 10 m/s

- (iii) 5 m/s

- (b) Apollo 7 was moving at almost 2000 m/s at stage 1 separation.
Use the formula to express this speed in miles per hour.

Question 12

$$\text{Distance} = \text{Speed} \times \text{Time}$$

This formula only applies when there is zero acceleration.

When there's zero acceleration the speed does not vary over the journey.

If there is some constant acceleration then the finishing speed and the starting speed differ and a different formula applies;

$$\text{Distance} = \text{Average Speed} \times \text{Time}.$$

(a) Find the average (the mean) of the following pairs of numbers;

(i) 12 and 18

(ii) 25 and 45

(iii) 2 and 7

(iv) 26 and 54

(b) A car accelerates such that it's speed increases uniformly from 8m/s to 34 m/s over 6 seconds.

What distance does this car cover whilst accelerating ?