

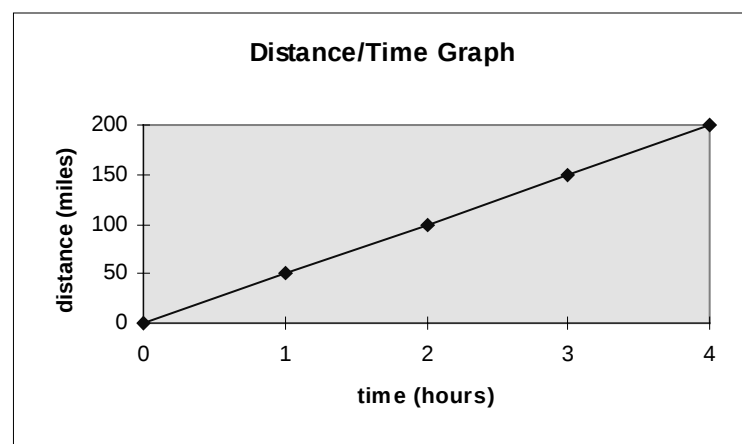
## LINEAR RELATIONSHIPS

### Example

A car travels at a steady speed of 50mph along a motorway.

The table shows the distances it would go in 1 hour, 2 hours, etc.

|                  |   |    |     |     |     |
|------------------|---|----|-----|-----|-----|
| Time t hours     | 0 | 1  | 2   | 3   | 4   |
| Distance d miles | 0 | 50 | 100 | 150 | 200 |



The distance can be found from the time by multiplying by 50. The points are on a straight line.

The gradient of the line is 50. The relationship between t and d is linear.

The distance, d, is directly proportional to the time t. [written  $d \propto t$ ]

### Task

The mass of a cubic centimetre of iron is 8 grams

(a) Copy and complete the table.

|                      |   |    |    |   |
|----------------------|---|----|----|---|
| Volume $\text{cm}^3$ | 1 | 2  | 3  | 4 |
| Mass g               | 8 | 16 | 24 | ? |

(b) Draw a graph to show the relationship. Check that the points are on a straight line.

(c) What is the gradient of the line ?

(d) When the volume is multiplied by 2, what happens to the mass ?

(e) What is the relationship between the volume and the mass ? Write the relationship in symbols.

### Extension

1) Investigate the following relationships and determine which are linear.

Comment on key features of any graphs drawn and where possible write the relationship in symbols.

(a) The table below shows the frequencies of the notes obtained from a stretched string under various tensions.

|                 |     |     |     |     |
|-----------------|-----|-----|-----|-----|
| Tension N       | 16  | 36  | 49  | 64  |
| Frequency Hertz | 200 | 300 | 350 | 400 |

(b) A small ball is thrown upwards with various initial speeds. The height it goes is recorded below.

|                        |     |      |      |       |
|------------------------|-----|------|------|-------|
| Speed $\text{ms}^{-1}$ | 8   | 18   | 22   | 27    |
| Height m               | 3.2 | 16.2 | 24.2 | 36.45 |

(c) The current through a resistor when connected to various cells was:

|                   |     |     |     |     |
|-------------------|-----|-----|-----|-----|
| Voltage V Volts   | 1.5 | 3   | 4.5 | 6   |
| Current I Amperes | 0.3 | 0.6 | 0.9 | 1.2 |

2) Find an example from your course which involves a relationship which is linear.

