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## Relationships as Graphs

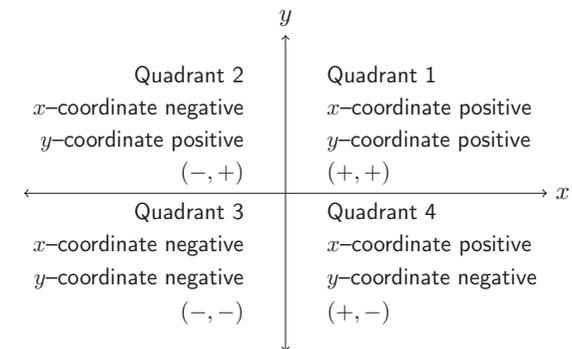
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### Relationships as graphs



- ▶ A seventeenth century mathematician named **René Descartes** developed a suitable system which we use today.
- ▶ The **Cartesian co-ordinate systems** is a grid and used two axes of reference — a horizontal or *x*-axis and a vertical or *y*-axis.
- ▶ These two axes intersect at a point called the origin.
- ▶ Any point can be described exactly by using an ordered pair of numbers associated with it in the Cartesian Plane — its (*x*-coordinate, *y*-coordinate) and abbreviate this to (*x*, *y*).
- ▶ The *x* and *y*-axes divide the cartesian plane into quarters. These quarters are called **quadrants** and are numbered as in the figure:



## Drawing Graphs



- ▶ The general purpose of a graph is to give a visual representation of the relationship between two or more things.
- ▶ Graphs must contain clear, precise and meaningful information for the reader.
- ▶ Using the Cartesian coordinate system, if we could find a number of ordered pairs, we could locate these on the Cartesian plane and join them up to get a graph of this relationship.

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## Example



Let consider brother and sister Shirley and Jeffrey. We know that Shirley is three years older than Jeffrey and that this is represented by the formula:

$$S = J + 3,$$

where  $S$  represents Shirley's age in years, and  $J$  represents Jeffrey's age in years. A convenient way to represent this information is to enter it in a **table of values**.

Jeffrey's age (years)	14	19	35
Shirley's age (years)	17	22	38

From our table of values we are able to write a series of ordered pairs that satisfy the formula.

$$(14, 17) \quad (19, 22) \quad (35, 38)$$

In each case Jeffrey's age (horizontal axis) comes first and Shirley's age (vertical axis) is second.

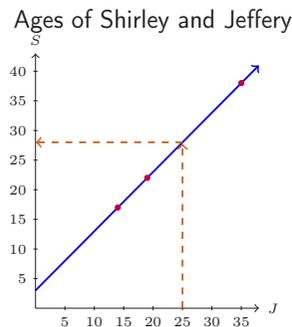
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## Example (cont)



Finally give the graph a title. Notice that we do not stop at the points we have plotted when drawing in the trend line. The points we have plotted were only three of an infinite number of possibilities.

Once the graph is drawn it is easy to read off Shirley's age for any age of Jeffrey.



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## Steps to draw a graph



Let us now summarise the steps we have taken to draw a graph.

1. Complete a table of values from the formula.
2. Draw up a Cartesian plane and label the axes (do not forget the units if appropriate).
3. Choose a suitable scale.
4. Plot the ordered pairs from the table of values.
5. Draw a trend line extending through and beyond the plotted points.
6. Give your graph a title.

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## Exercise



Before the invention of mechanical clocks, candles were sometimes used to measure the passage of time. A formula for the height of such a candle related to time is given below.

$$h = 10 - 2t,$$

where  $h$  equals the height of the candle in centimetres, and  $t$  equals the time in hours that the candle has been burning.

- Use this formula to complete the following table.

$t$	0	1	2	3	4	5
$h$						

- Graph this formula, letting the horizontal axis represent time.
- What was the height of the candle before it was lit?
- What does the 10 represent in the formula?
- For how many hours will the candle burn?

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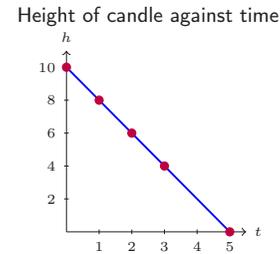
## Answer



- Required table of values.

$t$	0	1	2	3	4	5
$h$	10	8	6	4	2	0

- The graph is shown below.



- At time 0 hours (before the candle was lit), the height of the candle was 10 cm.
- The 10 in the formula represents the height of the candle before it was lit.
- After 5 hours the candle has a height of 0 cm so it cannot burn further. The candle burns for 5 hours.

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## Exercise



The Leaky Boat Company hires out paddle boats for \$7.50 an hour.

- Develop a formula relating the time you have the boat to the total cost of the hire. Do not forget to define your variables.
- Complete the following table of values.

Number of hours	1	2	3	5	8
Total cost (\$)					

- Draw a graph showing the time you have the boat against the cost of the hire.
- If a family decides to hire the boat for 4 hours in the morning, what will be the cost of the boat?

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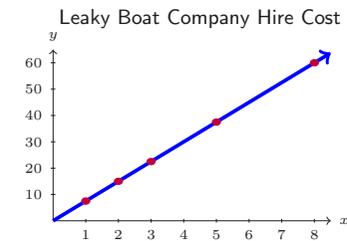
## Answer



- $H = 7.50t$ , where  $H$  represents the cost of hire in dollars, and  $t$  represents the time (in hours) that you have the boat.
- Table of values is shown below.

Number of Hours	1	2	3	5	8
Total cost (\$)	7.50	15.00	22.50	37.50	60.00

- Graph shown below.



- Cost for 4 hours hire will be \$30.00.

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