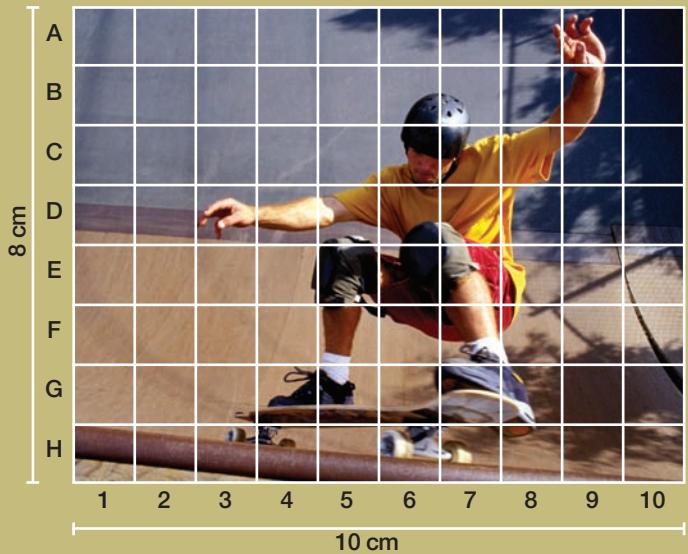


# MATHS

# MEETS

# ART

Some Art schools teach students to paint using the ‘grid method’, a method used by Leonardo da Vinci. The method involves overlaying a grid onto the image to be painted and also placing a matching grid pattern onto the canvas. For example, if the image shown is an  $8 \text{ cm} \times 10 \text{ cm}$  photograph,  $1 \text{ cm} \times 1 \text{ cm}$  squares can be used to create a grid pattern of eighty squares. If the image is to be copied onto an  $80 \text{ cm} \times 100 \text{ cm}$  canvas, each square will be  $10 \text{ cm} \times 10 \text{ cm}$ .

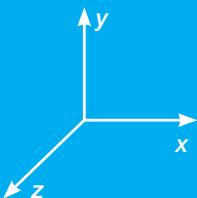


Note that the image and canvas above are not shown to scale.

- 1 State the coordinates of each of the following.
  - (i) right foot
  - (ii) left ear
  - (iii) left elbow
  - (iv) left hand
- 2 Suppose you wish to copy the image onto a canvas that is 16 cm × 20 cm.
  - (a) What size square on the canvas is needed to represent one square centimetre on the image?
  - (b) Use centimetre grid paper or graph paper to copy the image.

### Research

- The rule of thirds is based on the Fibonacci spiral. Find out how the spiral is created.
- Find out more about the art of Piet Mondrian, and either present a five minute talk with illustrations or prepare a poster.
- Zedism is a painting style that gives a 3-dimensional effect. It uses a third axis (called the z-axis) which is at right angles to the Cartesian plane. By using geometry and perspective, the effect is an illusion of form and structure.

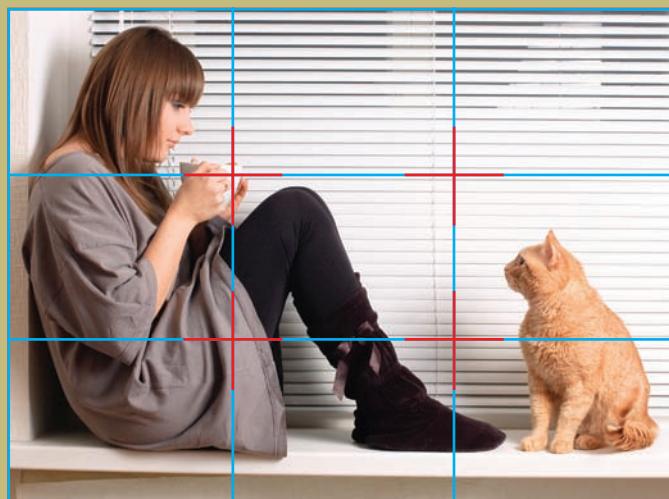


### The rule of thirds

A basic principle in photography and art is ‘the rule of thirds’. The image is divided into thirds horizontally and vertically to obtain nine squares or rectangles.

If points of interest are placed in any of the four marked intersections or along the lines, the image is more balanced and is pleasing to the eye.

- 3 Do you think ‘the rule of thirds’ was used in the composition shown below?
- 4 Use graph or grid paper to create an image of your own using ‘the rule of thirds’.



“Sky”



Find out how this is achieved and look for other examples of paintings where this method is used.

# 5.8

# Patterns and plotting points

When points are plotted on a number plane they often appear to follow a pattern or shape. This shape may be a straight line or it may be a curve. If we can draw a straight line through all the points we form a **linear graph**. Any set of points with a definite shape, such as a straight line, can be described by an algebraic rule.

## Worked Example 14

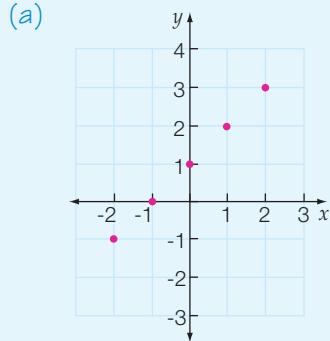
WE14

- Plot the points  $(-2, -1)$ ,  $(-1, 0)$ ,  $(0, 1)$ ,  $(1, 2)$  and  $(2, 3)$  on a number plane.
- Rule a straight line passing through all the points.
- Summarise the set of points in a table of values.
- Write down the rule linking the  $x$ - and  $y$ -values.

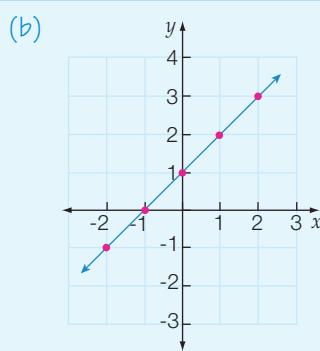
### Thinking

- (a) Use a ruler to draw and number the  $x$ - and  $y$ -axes on graph or grid paper. Label your axes and plot the points  $(-2, -1)$ ,  $(-1, 0)$ ,  $(0, 1)$ ,  $(1, 2)$  and  $(2, 3)$  moving left or right first, then up or down.

### Working



- (b) Join the points carefully with a ruler. You should have a straight line.



- (c) Construct a table with  $x$ -values on the top line and  $y$ -values on the second line.

$x$	-2	-1	0	1	2
$y$	-1	0	1	2	3

- (d) 1 Look for a link between the  $x$ - and  $y$ -values. (Each  $y$ -value is 1 more than the  $x$ -value.)

- 2 State the rule.

(d)

The rule is  $y = x + 1$ .

## Worked Example 15

We 15

- (a) List the coordinates of the points given in the table of values below.

$x$	-2	-1	0	1	2
$y$	-3	-1	1	3	5

- (b) Plot these points on a number plane.  
 (c) Rule a straight line passing through all the points.  
 (d) Write down the rule linking the  $x$ - and  $y$ -values.

Thinking

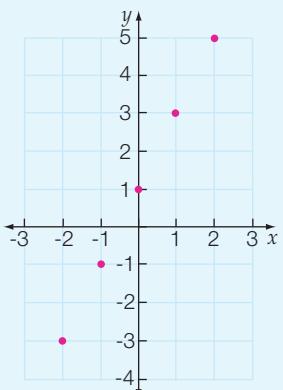
Working

- (a) Write the coordinates as an ordered pair with the  $x$ -coordinate first and the  $y$ -coordinate next.

(a)  $(-2, -3), (-1, -1), (0, 1), (1, 3), (2, 5)$

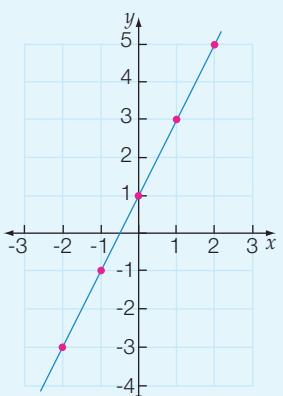
- (b) Use a ruler to draw and number the  $x$ - and  $y$ -axes on graph or grid paper. Label your axes and plot the points  $(-2, -3), (-1, -1), (0, 1), (1, 3)$  and  $(2, 5)$  moving left or right first, then up or down.

(b)



- (c) Join the points carefully with a ruler. You should have a straight line.

(c)



- (d) 1 Look for a link between the  $x$ - and  $y$ -values. (The  $y$ -values go up by 2, so we are multiplying by 2. Each  $y$ -value is 1 more than twice the  $x$ -value.)

(d)

- 2 State the rule.

The rule is  $y = 2x + 1$ .

# 5.8 Patterns and plotting points

## Navigator

**Answers  
page 653**

Q1, Q2, Q3, Q4, Q5, Q6, Q7,  
Q10

Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q9,  
Q10

Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8,  
Q9, Q10

**Equipment required:** Graph paper

## Fluency

**WE14**

- 1 (a) Plot the points  $(-2, 0)$ ,  $(-1, 1)$ ,  $(0, 2)$ ,  $(1, 3)$  and  $(2, 4)$  on a number plane.
- (b) Rule a straight line passing through all the points.
- (c) Summarise the set of points in a table of values.
- (d) Write down the rule linking the  $x$ - and  $y$ -values.

**WE15**

- 2 (a) List the coordinates of the points given in the table of values below.

$x$	-1	0	1	2	3
$y$	-3	-1	1	3	5

- (b) Plot these points on a number plane.
- (c) Rule a straight line passing through all the points.
- (d) Write down the rule linking the  $x$ - and  $y$ -values.
- 3 (a) Plot the points  $(1, 6)$ ,  $(2, 5)$ ,  $(3, 4)$ ,  $(4, 3)$ ,  $(5, 2)$  and  $(6, 1)$  on a number plane.
- (b) Join the points in this order.
- (c) Summarise the set of points in a table.
- (d) Write down the rule linking the  $x$ - and  $y$ -values.

## Understanding

- 4 Which one of the points  $(-1, -1)$ ,  $(2, 2)$ ,  $(3, 4)$  and  $(5, 5)$  will not lie on the same straight line as the three other points?
 

A  $(-1, -1)$       B  $(2, 2)$       C  $(3, 4)$       D  $(5, 5)$
- 5 (a) Plot the points  $(-2, 8)$ ,  $(0, 6)$  and  $(5, 1)$  on a number plane.  
 (b) Draw a straight line passing through all the points.  
 (c) What is the  $y$ -coordinate of a point on the line if its  $x$ -coordinate is  $-1$ ?  
 (d) What is the  $x$ -coordinate of a point on the line if its  $y$ -coordinate is  $5$ ?
- 6 (a) Plot the points  $(1, 1)$ ,  $(1, 5)$ ,  $(5, 5)$  and  $(5, 1)$  on a number plane and join the points in order.  
 (b) Name the geometrical figure drawn in part (a).

## Reasoning

- 7 (a) Plot the points  $(0, 0)$ ,  $(2, 2)$  and  $(-5, -5)$  on a number plane.  
 (b) Draw a straight line passing through all the points.  
 (c) Write down the coordinates of three other points through which the line passes.

- (d) Summarise the set of points in a table.
- (e) Write down the rule linking the  $x$ - and  $y$ -values.
- (f) By substituting  $x = -3$  into the rule, show that the point  $(-3, -3)$  lies on the line.
- 8 (a) Plot the points  $(-1, -5)$  and  $(5, 13)$  on a number plane and join them with a straight line.
- (b) Write down the coordinates of three other points through which the line passes.
- (c) Summarise the set of points in a table.
- (d) Write down the rule linking the  $x$ - and  $y$ -values.
- (e) Substitute  $x = 0$  into the rule to show that  $(0, -3)$  does not lie on the line.
- (f) Plot  $(0, -3)$  on the number plane to confirm it does not lie on the line.

## Open-ended

- 9 (a) Plot the point  $(3, 3)$  on a number plane.
- (b) Draw a straight line passing through this point and one other point.
- (c) Write down the coordinates of two other points through which the line passes.
- (d) Write down the rule linking the  $x$ - and  $y$ -values for this straight line.
- (e) Repeat (b), (c) and (d) using  $(3, 3)$  and a different point to find a different rule.
- 10 Using  $-4$  to  $4$  on the  $x$ - and  $y$ -axes:
- choose a point and write down its coordinates
  - choose two other points that will form a line that is not vertical or horizontal
  - find the rule for that line.

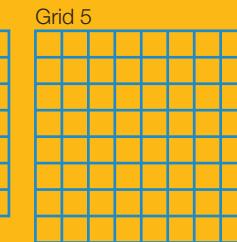
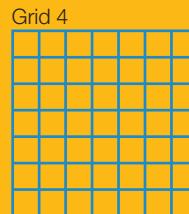
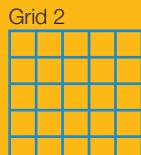
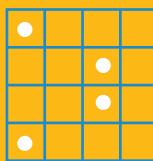
# Outside the Square Puzzle

## Gridlock

**Equipment required:** 1 brain, grid or graph paper

- (a) In grid 1, mark four squares so that no two marked squares lie in the same row, column or diagonal.

For example, the arrangement shown is not allowed.



- (b) In grid 2, mark five squares so that no two marked squares lie in the same row, column or diagonal.
- (c) Mark six squares in Grid 3 and seven squares in Grid 4 so that no two marked squares lie in the same row, column or diagonal.
- (d) The challenge: Mark eight squares in Grid 5 so that no two marked squares lie in the same row, column or diagonal.



# SPY VS SPY

## Equipment required:

For task #1: 1 brain, graph paper, ruler

For task #2: 1 brain

For task #3: 2 brains, 1 die, counters or small pieces of paper

While working on Operation Cartesian as a spy for the Confederation of Mathematicians, Freedo has been caught by the Anti-maths guerrilla forces deep in the jungle.

## Task #1: Frame the assassin

Freedo's last communication from headquarters gave him a picture of 'Zero', the most deadly of the Anti-maths guerrillas.

To decipher the picture, Freedo must apply his knowledge of Cartesian graphs. On your graph paper begin by creating a set of axes, from -8 to 8 along the  $x$ -axis and -10 to 7 along the  $y$ -axis.

Use a ruler to join each of the following sets of coordinates, like a dot-to-dot drawing. Where there is a •, lift your pen and start a new line without joining to the previous lines drawn.

(0, 7), (2, 7), (4, 6), (6, 4), (6, 1), (7, 2), (8, 0), (7, -2),  
(6, -3), (5, -5) •

(4, -6), (3, -8), (1, -10), (0, -9) •  
(0, -8), (1, -7), (3, -7), (1, -6), (0, -6) •  
(3, -7), (1, -5), (0, -5) •  
(0, 2), (2, 4), (5, 4), (3, 3), (1, 1), (1, -1), (2, -2), (1, -3),  
(0, -3) •  
(0, -4), (1, -3), (3, -4), (6, -6), (4, -6), (1, -4), (0, -4) •  
(6, -1), (7, -1), (7, 1), (6, 0) •  
(1, 1), (2, 0), (5, 1), (4, 2), (2, 2), (2, 1), (3, 1), (3, 2) •

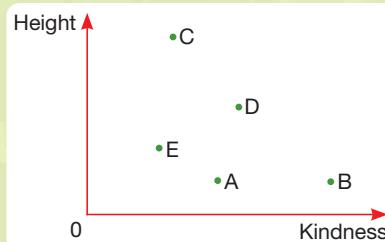
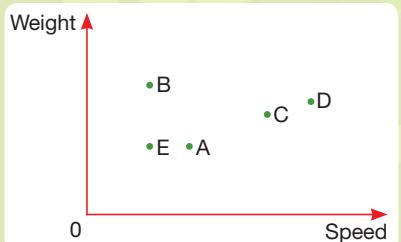
Then complete the image by drawing a reflection of the current image in the  $y$ -axis.

## Task #2: Guard help

Freedo is locked in a cage. He was given the following information from headquarters:

*'The guard who will help you is one of the two shortest guards and one of the two slowest guards.'*

Looking at the following graphs can you figure out which guard will help Freedo?



## Task #3: Quadrant Tic Tac Toe

Play this game to see if you are able to escape from the Anti-maths guerrilla forces.

Choose who will play the role of Zero and who will play the role of Freedo. Will Freedo escape?

Your aim is to be the first to have 3 counters in a row, column or diagonal.

Take turns in rolling. You can place counters on the intersections of the grid lines, according to the following rules.

Rolling a 1 means you must place a counter in quadrant 1.

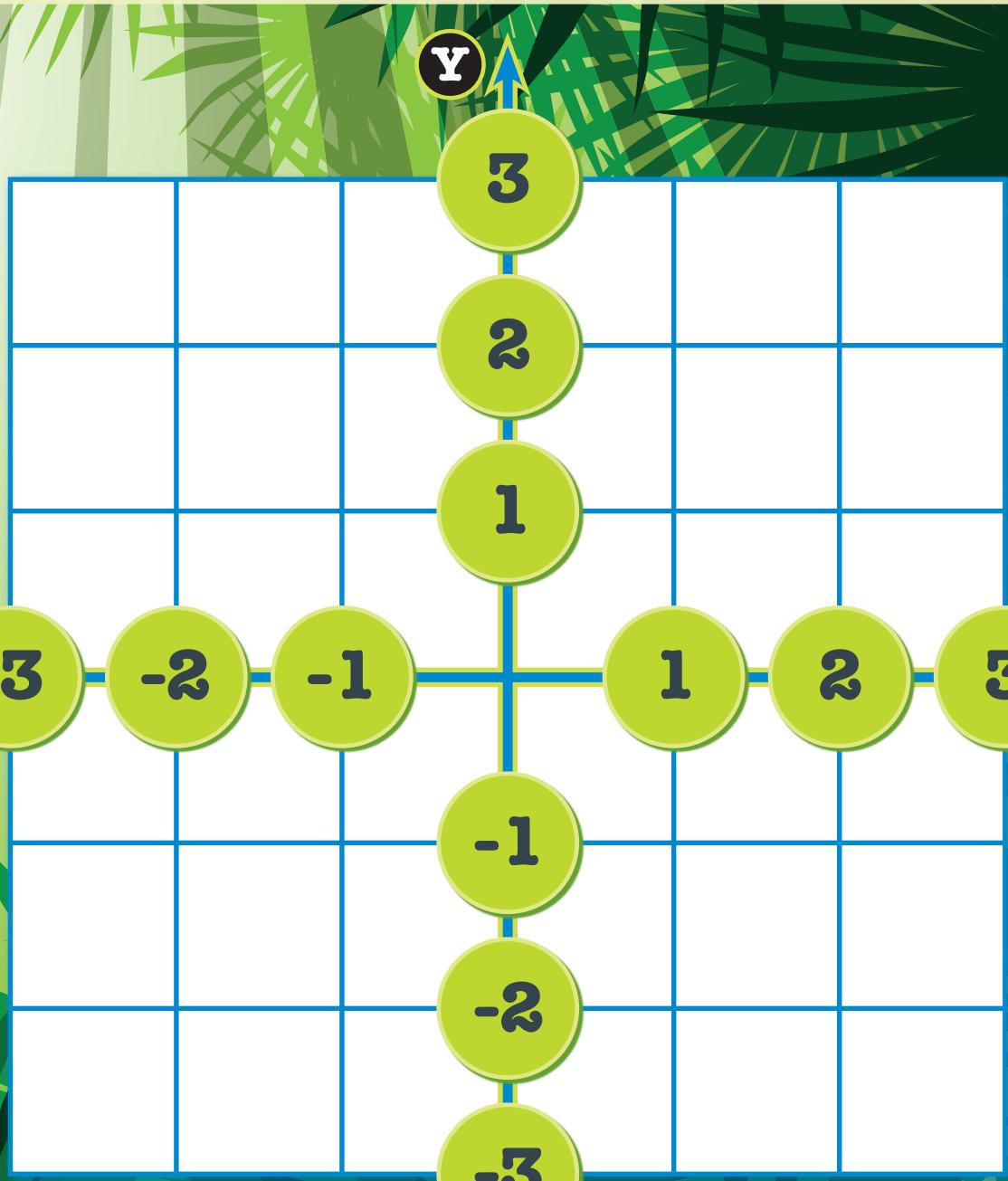
Rolling a 2 means you must place a counter in quadrant 2.

Rolling a 3 means you must place a counter in quadrant 3.

Rolling a 4 means you must place a counter in quadrant 4.

Rolling a 5 means you must place a counter on the  $x$ -axis.

Rolling a 6 means you must place a counter on the  $y$ -axis.



# 5.9

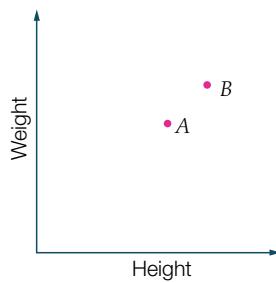
# Interpreting graphs

Sometimes, when we plot points showing information relating to two variables, the points should not be joined.

This type of graph is called a **point graph**.

In the graph below, the points labelled A and B tell us about the height and weight of Oscar and Theodore.

Point A matches Theodore (smaller height and lower weight) and point B matches Oscar (taller and heavier). The graph shows that Oscar is taller than Theodore and that Theodore weighs less than Oscar.



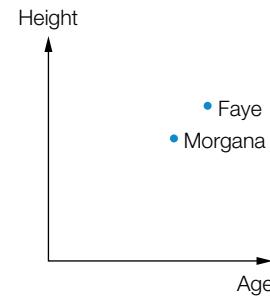
## Worked Example 16

WE16

This graph shows the age and height of Faye and Morgana.

Answer TRUE or FALSE to each of these statements.

- Faye is taller than Morgana.
- Morgana is older than Faye.
- Faye is younger than Morgana.
- Morgana is shorter than Faye.



### Thinking

- Compare heights. Height increases the further you move up the vertical axis. The point for Faye is higher, so she is taller than Morgana.
- Compare ages. Age increases the further you move to the right. The point for Faye is further to the right, so she is older than Morgana.
- Compare ages. Faye is older than Morgana as the point for Faye is further to the right.
- Compare heights. The point for Morgana is lower, so she is shorter than Faye.

### Working

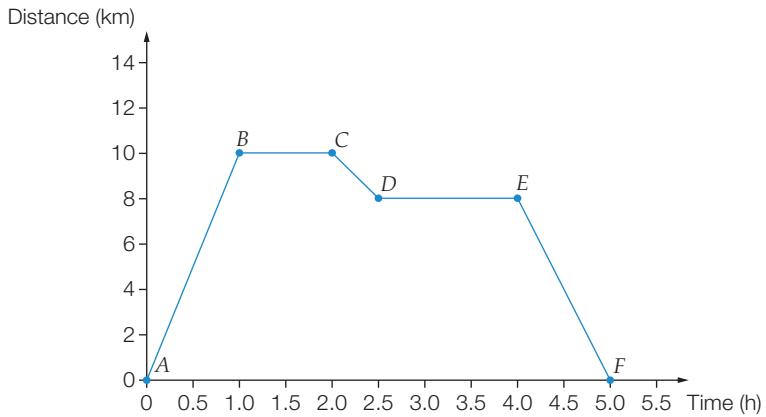
- Faye is taller than Morgana. TRUE
- Morgana is older than Faye. FALSE
- Faye is younger than Morgana. FALSE
- Morgana is shorter than Faye. TRUE

If we join points with straight lines, they may not form a linear graph, as the points may not all lie on the same straight line. These graphs are called **line graphs**. An example of line graphs are travel graphs where time is plotted on the  $x$ -axis and distance is plotted on the  $y$ -axis. When lines are horizontal, the distance is not changing. When lines are steepest, the speed is greatest.

## Worked Example 17

WE17

May and Kim go jogging. They leave from Kim's house, jog to their friend Jenny's place, stay there for a swim, then jog to May's place. They stay there for a while and watch a DVD before jogging back to Kim's house.



Using the graph given above that shows their journey, answer the following questions.

- What are the graph coordinates of Kim's house?
- How far away from Kim's house does Jenny live?
- How long did it take to reach Jenny's house?
- How long did they stay at Jenny's house?
- How far from Kim's place does May live?
- How long did they stay at May's house?
- How long were they away from Kim's house?
- When were they jogging the fastest?

### Thinking

### Working

- |  |            |
|--|------------|
| (a) Identify where the journey begins (A).   | (a) (0, 0) |
| (b) Look for the distance to B on the $y$ -axis.<br>The $y$ -coordinate of B gives that distance.  | (b) 10 km  |
| (c) Look for the time taken to get from A to B on the $x$ -axis. The $x$ -coordinate of B gives the time.                                      | (c) 1 h    |
| (d) The horizontal line BC shows that they stayed in the same place during this time, so the time will be the time difference between B and C. | (d) 1 h    |
| (e) Look for the distance D on the $y$ -axis. The $y$ -coordinate of D gives the distance.   | (e) 8 km   |



- (f) The horizontal line  $DE$  shows that they stayed in the same place during this time, so the time will be the time difference between  $D$  and  $E$ . (f)  $1\frac{1}{2}$  h
- (g) Look for the time to get from  $A$  to  $F$  on the  $x$ -axis. The  $x$ -coordinate of  $F$  gives the time. (g) They were away for 5 hours.
- (h) Look for the steepest line. This is the line from  $A$  to  $B$  at the start of the jog. (h) They jogged fastest from Kim to Jenny's place.

## 5.9 Interpreting graphs

### Navigator

**Answers**  
page 655

Q1, Q2, Q3, Q4, Q5, Q6, Q8,  
Q11, Q14

Q1, Q2, Q3, Q4, Q5, Q6, Q8, Q9,  
Q10, Q11, Q12, Q14

Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8,  
Q9, Q10, Q12, Q13, Q14

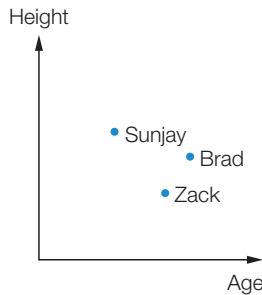
### Fluency

**WE16**

- 1 This graph shows the age and height of Sunjay, Zack and Brad.

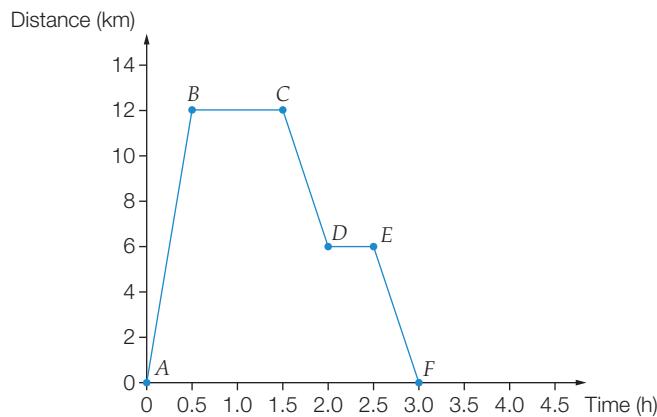
Answer TRUE or FALSE to each of these statements.

- (a) Brad is taller than Sunjay.
- (b) Zack is the shortest.
- (c) Brad is older than Zack.
- (d) Sunjay is the youngest.



**WE17**

- 2 Ray and Jim go for a bike ride. They leave from Jim's house, ride to their friend Terry's house, stay there for lunch, and then ride to Ray's house. After a short break, they ride back to Jim's house.



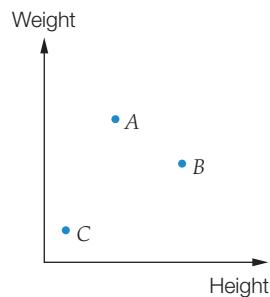
Using the graph given above that shows their journey, answer the following questions.

- (a) What are the graph coordinates of Jim's house?
- (b) How far away from Jim's house does Terry live?
- (c) How long did it take to reach Terry's house?
- (d) How long did they stay at Terry's house?
- (e) How far from Jim's house does Ray live?

- (f) How long did they stay at Ray's house?  
 (g) How long were they away from Jim's house?  
 (h) When were they riding the fastest?
- 3 Use the graph opposite to answer the following questions.
- Who is the youngest?
  - Who takes the smallest shoe size?
  - What can you say about the shoe sizes of Yiannis and Alex?
  - What can you say about the ages of Meg and Alex?

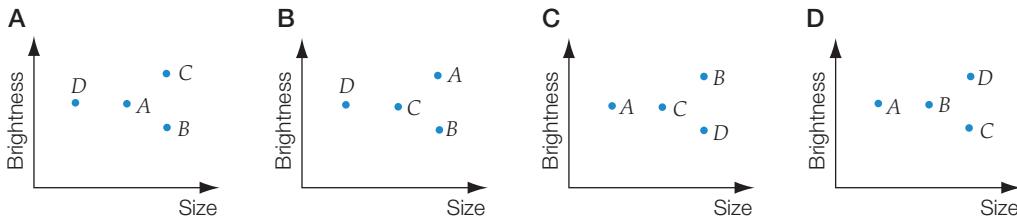


- 4 Consider this graph showing the weight and height of an elephant, a giraffe and a kangaroo. Match each point with the animal it represents.

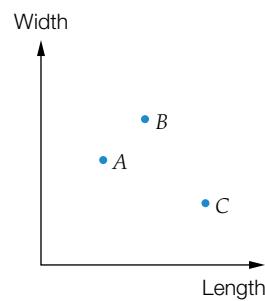
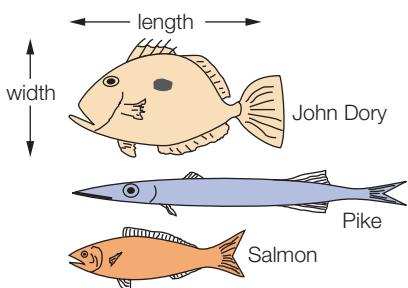


## Understanding

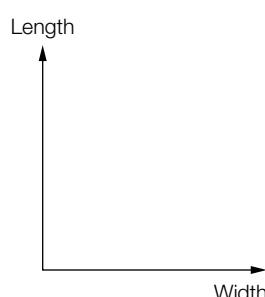
- 5 Four light globes, A, B, C and D have the properties that globe A and globe B are equally bright and globe C and globe D are of equal size. Which graph can represent this situation?



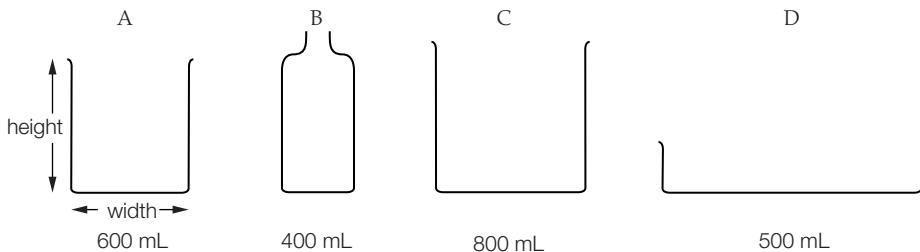
- 6 Consider this graph showing the widths and lengths of various fish.



- Match each point with the fish it represents.
- Copy and complete this graph to show the positions of the points A, B and C for the three fish.

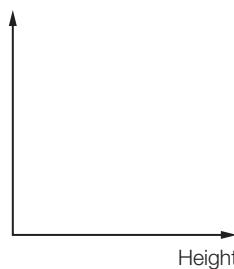


7

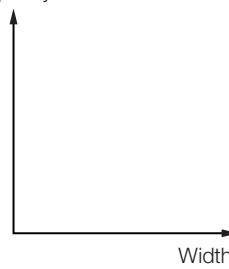


Complete the following point graphs for the containers A, B, C and D.

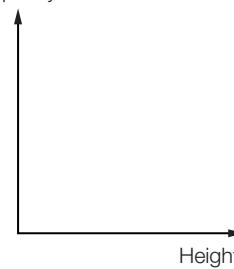
(a) Width



(b) Capacity



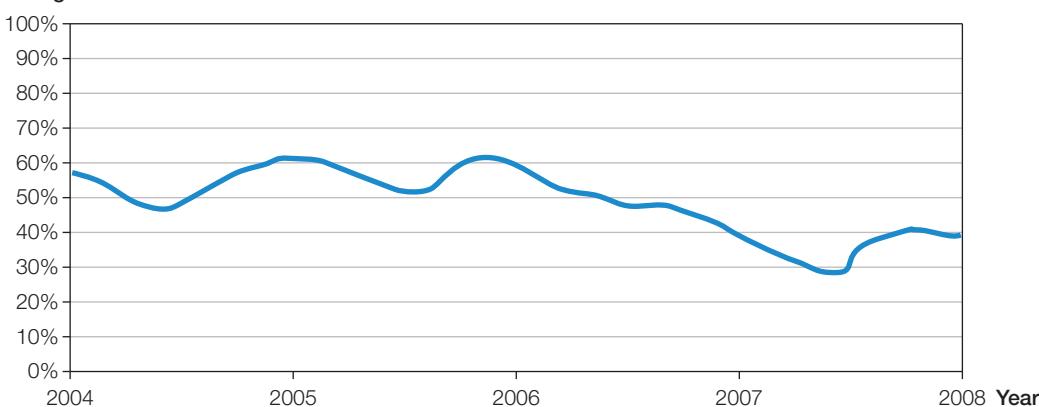
(c) Capacity



- 8 Large cities are usually surrounded by dams that collect rain to supply the city with water. The total amount of water stored in the dams is called the water storage and when this amount is calculated as a percentage of the total capacity of all the dams it gives a measure of how full the dams are on average.

Total system storage

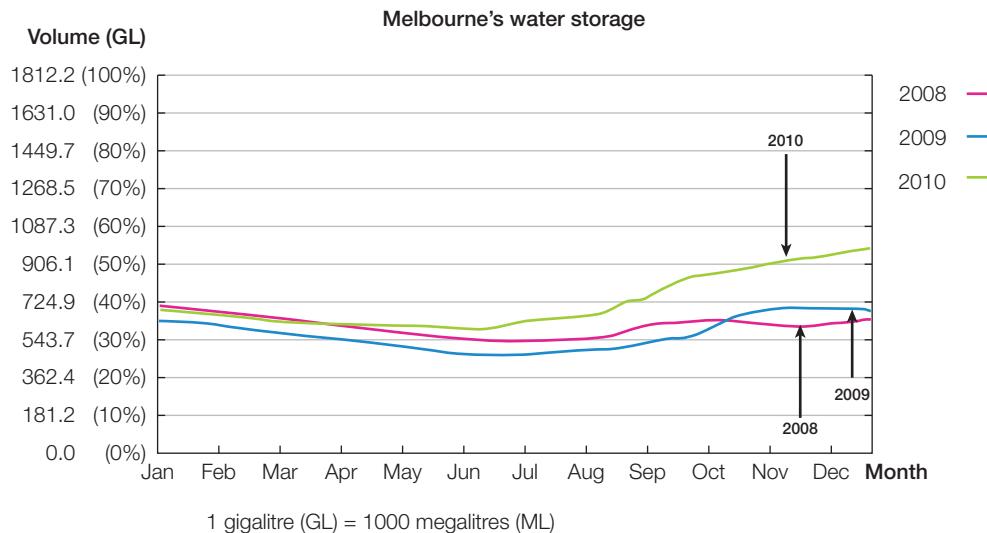
Melbourne's water storage



Above is a graph of Melbourne's water storage from 2004 to 2008. Use this graph to answer the following questions.

- (a) What was the storage percentage at the start of 2004?
- (b) Why did the water storage percentage rise in the second half of 2004?
- (c) Why is there an increase in storage percentage in the second half of each year (except 2006)?
- (d) What does the graph tell you about Melbourne's rainfall from the start of 2006 to mid 2007?
- (e) When was the water storage the lowest in the time period 2004–2008? What was the lowest percentage level reached?

9



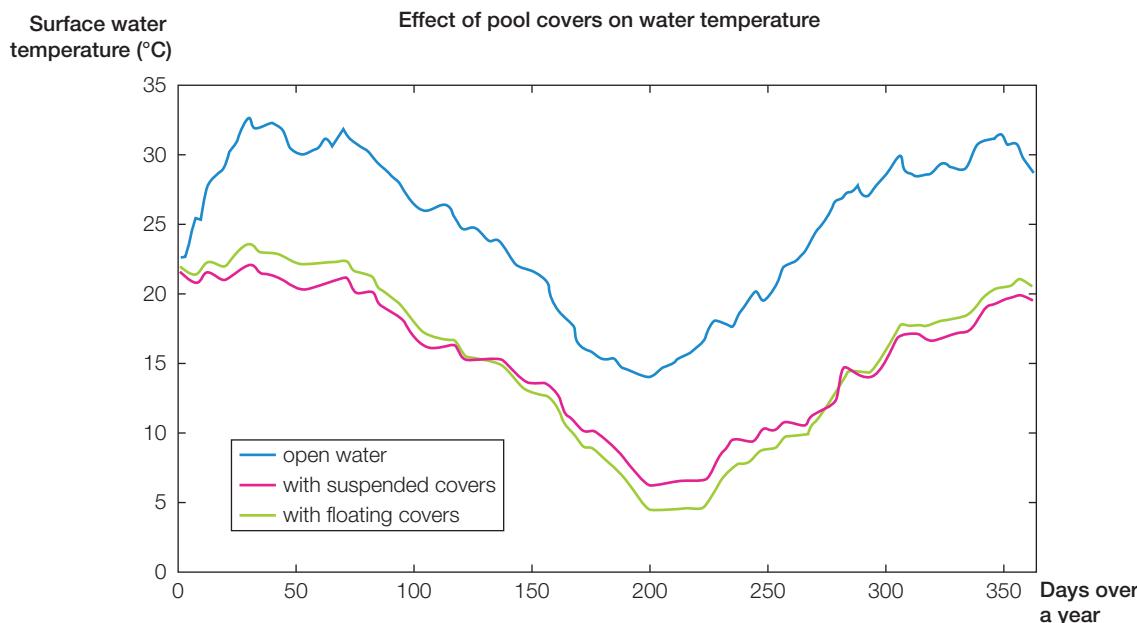
Above is a graph of Melbourne's water storage for the years 2008, 2009 and 2010.

Use this graph to answer the following questions.

- Compare the storage levels at the start of 2008, 2009 and 2010. Were the levels similar? Which year started with the lowest storage level? What was the difference between the highest and lowest storage percentage at the start of each year?
- Compare the storage levels at the end of 2009 and 2010. What is the difference in storage percentage?
- During which 3 months over the 3 year period was the storage level the highest?
- During which 3 months over the 3 year period was the storage level the lowest?

## Reasoning

- 10 Evaporation is a major source of water loss from storage facilities. The rate at which water evaporates increases as temperature increases. The lower the temperature of the water, the less water will be lost to evaporation.



Above is a graph showing the effect on water temperature of using covers of different types on a pool. Use this graph to answer the following questions.

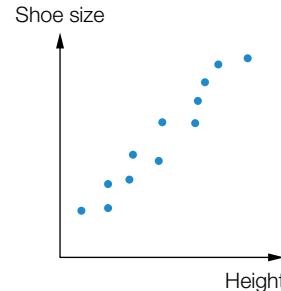


The largest foot has been measured at 47 cm in length.

- Do you think covers reduce evaporation? Give reasons for your answer.
- Is one type of cover more effective than the other at reducing evaporation? Give reasons for your answer.
- When is a floating cover more effective than a suspended cover?
- What effect overall does the use of pool covers have on the water temperature?

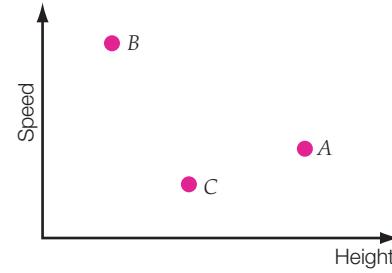
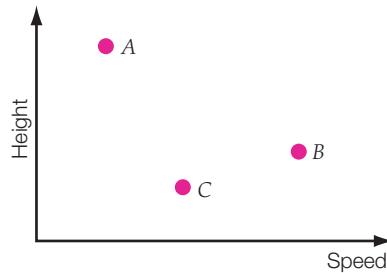
- 11 (a) What are the two variables shown in this graph?

- (b) What happens to the shoe size as the height increases?



### Open-ended

- 12 Agnes transferred the points on the first graph to the graph with swapped axes. She left C in the same place but swapped the positions of A and B.



- Explain why Agnes' actions are not correct for these graphs. When would it be correct to do the simple swap with A and B?
  - What would need to be the properties of a point if it is to stay in the same place?
  - Draw what the second graph should look like.
- 13 Tom, Adam, Sheena and Toula play basketball. Sheena is shorter than Tom, and Toula scores more points than Adam. One point of view is that the taller the basketball player, the more points they score. Using the variables 'Height' and 'Points scored', draw two possible graphs that show the relationship.
- 14 Draw a travel graph of your own and write a few sentences to explain the journey.

## Outside the Square Puzzle

### Solve the grid

Each letter stands for a different number, but it represents the same number each time it is used. The total for the first row and the first two columns is given.

D	D	E	D	39
E	D	D	E	
E	E	E	X	
X	E	X	X	

40 42

- 1 What number does X represent?

- 2 Find the total of each of the other rows and columns.



# Challenge 5



- 1 George has 15 coins, all 50c and 20c pieces. If the 20c pieces were 50c pieces and the 50c pieces were 20c pieces, he would have \$2.10 more. How many 50c pieces does he actually have?
- 2 If  $p \ast q$  means  $3(p + q)$ , what is the value of  $5 \ast (2 \ast 8)$ ?
- 3 Steven and Claire live next door to each other. The product of their house numbers is 483. What are their house numbers?
- 4 If  $x > 4$ , put these terms in order from smallest to largest.

$$\frac{x}{4} \quad \frac{4}{x} \quad \frac{4}{x+1} \quad \frac{x+1}{4}$$

- 5 Each letter represents one of the digits 1, 2, 3, 4 or 5.

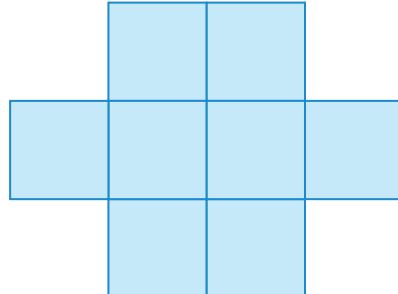
$$\begin{array}{r} \text{K L} \\ \times \text{ M} \\ \hline \text{P N} \end{array}$$

The answer to this multiplication is correct.

Which statement is correct?

- A**  $K = 3$       **B**  $L = 3$       **C**  $M = 3$       **D**  $N = 3$
- 6 What are possible positive values for  $a$  and  $b$  if  $(a \times b)^2 = a \times b^2$ ?
  - 7 In a 30-question test you earn 9 marks for every correct answer and lose 5 marks for every wrong answer. You must attempt every question.
    - (a) How many marks do you get for 15 correct answers? (Assume you attempt all the questions.)
    - (b) What is the greatest number of marks you can get if you have more answers wrong than correct?
    - (c) Is it possible to score exactly zero on the test? Explain why or why not.

- 8 Place one of the numbers 1, 2, 3, 4, 5, 6, 7 and 8 in each square so that no consecutive numbers are beside each other; that is, 2 is not next to a 3 either above, below, to the left or to the right.



- 9 If half the number represented by  $x$  is 24, what is the value of  $2x$ ?
- 10 The sum of three consecutive integers is 90. What is the smallest of the three integers?

**A** 28      **B** 29      **C** 30      **D** 31
- 11 Find two numbers which when multiplied together make 1 000 000 if neither of the numbers contains any zeroes.

## 5

# Chapter review

## D.I.Y. Summary

### Key Words

axes	equation	linear graph	relationship	variable
Cartesian plane	evaluate	ordered pair	substitute	
coefficient	expression	origin	table of values	
constant	formula	point graph	terms	
coordinates	like terms	pronumeral	unknown	
define	line graph	quadrant	unlike terms	

Copy and complete the following using the words and phrases from this list, where appropriate, to write a summary for this chapter. A word or phrase may be used more than once.

- 1 A \_\_\_\_\_ is a letter or a symbol that represents a number.
- 2 Completing a \_\_\_\_\_ is helpful when finding the \_\_\_\_\_ that describes a pattern.
- 3 To find the value of the expression  $2x + 3$ , when  $x = 1$ , we need to \_\_\_\_\_ 1 for  $x$ , and \_\_\_\_\_ the expression.
- 4 The \_\_\_\_\_ is the point  $(0, 0)$ . It is the point where the two \_\_\_\_\_ of the Cartesian plane intersect.
- 5 A pronumeral represents an \_\_\_\_\_ or a \_\_\_\_\_.
- 6 A number written next to a pronumeral is the \_\_\_\_\_ of the pronumeral. The pronumeral is multiplied by that number.
- 7 To simplify the expression  $3x + 4x + 5$  you collect \_\_\_\_\_.
- 8 The \_\_\_\_\_  $(3, 5)$  can be plotted on the \_\_\_\_\_ by finding the point 3 across and 5 up. Draw a diagram clearly showing this point plotted in its correct location.

### Fluency

- 1 Write the following situations using algebra.
  - (a) There are 12 biscuits in a packet. How many are in  $n$  packets?
  - (b) Tarin has a packet of  $p$  lollies. He eats half, then gives 3 to his brother. How many lollies does he have left?
  - (c) Multiply  $p$  by 7, then subtract 9.
  - (d) Subtract  $g$  from 11, then divide by 5.
- 2 Write an equation for each of the following situations, taking care to define all the variables you have used.
  - (a) Joe's age in years is four plus three times Beth's age.
  - (b) Three bottles of juice and five salad rolls cost \$18.60.

Ex. 5.1

Ex. 5.2

- 3 For each of the following rules:

- (i) draw a flowchart that shows how to get to  $y$  from  $x$
- (ii) write the rule using algebra
- (iii) copy and complete the table of values for that rule.

(a) Add three to  $x$  to get  $y$ .

(b) To find  $y$ , multiply  $x$  by three, then subtract five.

$x$	57	34	12	4	1.1	64
$y$						

$x$	4	3	$2\frac{1}{2}$	9	10	12
$y$						

- 4 Choose the correct algebraic notation for each rule.

(a)  $y$  is equal to  $x$  plus 6.

A  $y = x - 6$

B  $y = x + 6$

C  $y = x \times 6$

D  $x = y + 6$

(b) Subtract five from  $x$ , then multiply by three to get  $y$ .

A  $y = (x - 3) \times 5$

B  $y = (x + 5) \times 3$

C  $y = (x - 5) \times 3$

D  $y = x - 5 \times 3$

- 5 For each of the following formulas, evaluate  $p$  by substituting the given values of  $a$ .

(a)  $p = 6 - 20a$

(i)  $a = 3$

(ii)  $a = -1$

(b)  $p = 2(a - 4) + 11$

(i)  $a = 2$

(ii)  $a = -5$

- 6 If you substitute  $x = 3$  into the formula  $y = 5x - 2$ , the value of  $y$  is:

A  $y = 3$

B  $y = 5$

C  $y = 13$

D  $y = 17$

- 7 Use each of the following rules to complete the tables of values.

(a)  $y = x - 7$

(b)  $y = 10(x - 3)$

$x$	7	9	12	20	8.1	107
$y$						

$x$	4	$5\frac{1}{2}$	13	7	78	54
$y$						

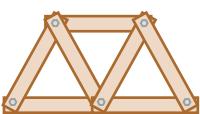
- 8 The frame of a bridge is made up of triangular sections. The triangles are made up of girders held together by bolts.



1 triangle  
3 girders  
3 bolts



2 triangles  
5 girders  
4 bolts



3 triangles  
7 girders  
5 bolts

- (a) Complete the table of values by continuing the pattern.

Number of triangles ( $t$ )	1	2	3	4	5
Number of girders ( $g$ )	3	5			
Number of bolts ( $b$ )	3	4			

- (b) Write down the rule that relates the number of triangles,  $t$ , to the number of girders,  $g$ .

- (c) Write down the rule that relates the number of triangles,  $t$ , to the number of bolts,  $b$ .

**Ex. 5.3**

**Ex. 5.3**

**Ex. 5.4**

**Ex. 5.4**

**Ex. 5.4**

**Ex. 5.5**

- (d) (i) How many girders are needed to create each extra triangular section?  
(ii) How is this reflected in the table of values and the rule?
- (e) (i) How many bolts are needed for each new triangular section?  
(ii) How is this reflected in the table of values and the rule?

9 Simplify each expression by adding or subtracting like terms.

(a)  $12a - 7a$

(b)  $6a + 12b - 7a + 11b$

(c)  $x + y + 3x$

**Ex. 5.6**

10 Write the coordinates of each of the following points shown on the Cartesian plane.

(a)  $P$

(b)  $Q$

(c)  $R$

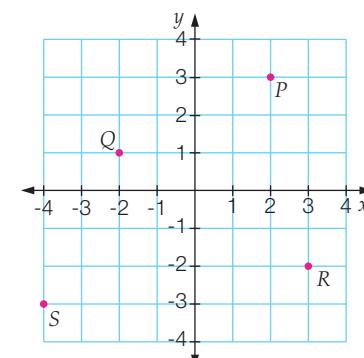
(d)  $S$

**Ex. 5.7**

11 (a) Plot the points  $(-1, -4)$ ,  $(1, 2)$ ,  $(2, 5)$  and  $(3, 8)$  on a number plane and draw a straight line passing through all the points.

(b) Summarise the set of points in a table.

(c) Write down a rule linking the  $x$ - and  $y$ -values.



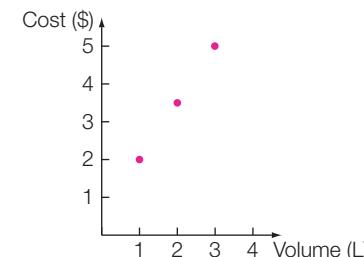
**Ex. 5.8**

12 Juice is sold in three sizes: 1 L, 2 L and 3 L. Use the graph opposite to answer the following questions.

(a) How much does a 2 L juice cost?

(b) Which size is the best value? Why?

(c) Why is this information given in a point graph?



**Ex. 5.9**

## Understanding

13 Gayle, the kindergarten teacher, has 8 packets of crayons with  $n$  crayons in each packet, plus an extra 3 loose crayons.

(a) Write an expression for the total number of crayons Gayle has.

(b) If all the crayons are to be shared equally between the 15 children in Gayle's class so that none are left over, write an expression to show how many crayons each child receives.

(c) Find the smallest possible value for  $n$ .

14 Draw a flowchart for each of the following rules.

(a)  $h = 7g$

(b)  $d = 9c - 2$

(c)  $d = \frac{c}{10} + 13$

(d)  $h = 5(g + 8)$

15 Tamsin is working out the number of bottles of soft drink she needs for a party. She is going to allow 1 bottle for every 4 people, plus 5 extra bottles.

(a) Write out Tamsin's rule using algebraic notation. Let  $b$  = number of bottles of drink required and  $n$  = number of people at the party.

(b) If Tamsin has 16 people at the party, how many bottles of drink will she need?

16 Simplify if possible:

(a)  $2a - 7b + 3a + 2$

(b)  $5a + 12b - 7 - 3b$

(c)  $x + y + xy$

- 17 The points  $(0, 1)$ ,  $(2, 5)$  and  $(5, 11)$  are plotted on a number plane and a straight line drawn through the points. Which one of the following points also lies on the line?

A  $(1, 2)$

B  $(3, 7)$

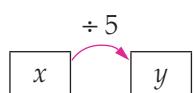
C  $(3, 6)$

D  $(4, 10)$

## Reasoning

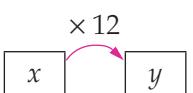
- 18 The following tables of values have only the  $y$ -values filled in. Work backwards along the flowchart to determine the values of  $x$  that were used, and complete the tables.

(a)



$x$						
$y$	2	-7	20	1	0	-6

(b)



$x$						
$y$	72	120	36	-12	0	60

- 19 For each of these tables, find the rule that is being used.

(a)

$x$	76	54	8	28	9	103
$y$	69	47	1	21	2	96

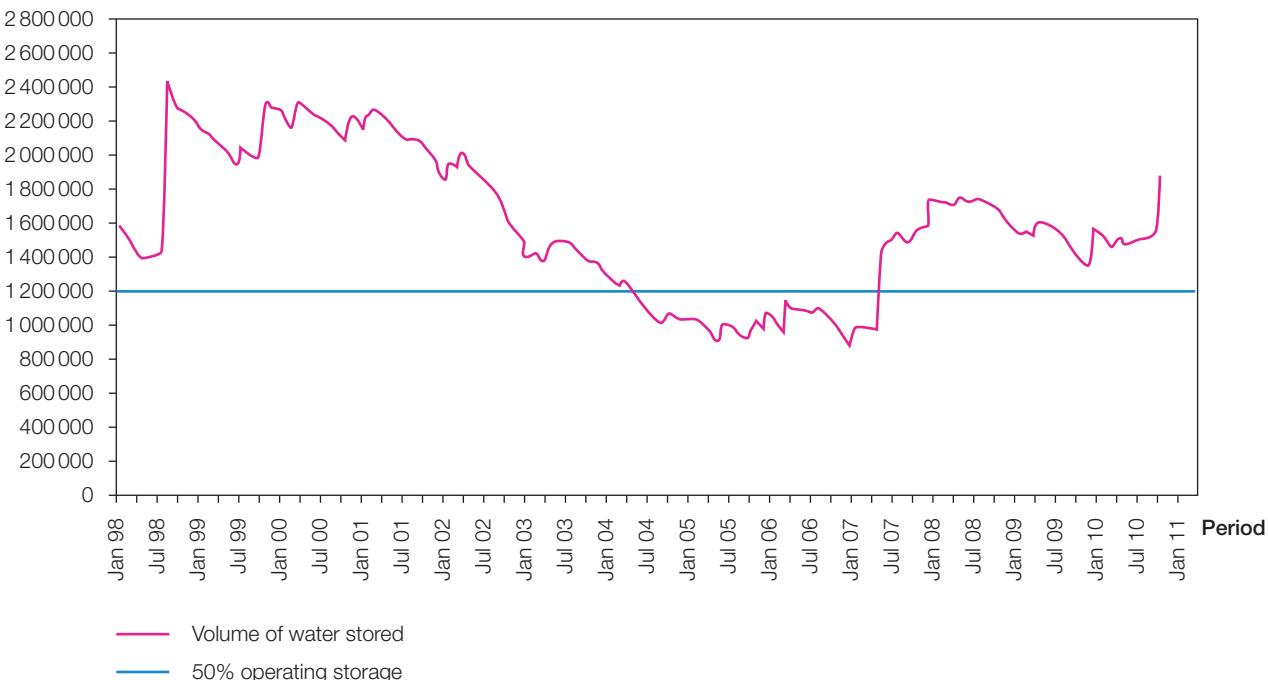
(b)

$x$	15	10	2	7.3	9	22
$y$	34	24	8	18.6	22	48

- 20 Jack has \$21.00 to buy some apples and oranges. An apple costs \$1.80 and an orange costs \$1.40.

- (a) Using appropriate pronumerals to represent the number of apples and oranges purchased, write an equation to show the situation when Jack spends all of the \$21.00.  
 (b) How many apples and how many oranges could Jack buy using all the money?  
 (c) If Jack buys 4 apples and 5 oranges, how much change will he receive?

- 21 Megalitres



Above is a graph of Sydney's water storage from 1998 to 2010. The volume of water stored is given in megalitres (ML).  $1 \text{ ML} = 1\,000\,000$  litres.

Use this graph to answer the following questions.

- (a) What was the volume of water (in megalitres) at the start of 2010?
- (b) During which month and year were the dams the fullest?
- (c) During which month and year were the dams at their lowest capacity?
- (d) What does the shape of the graph tell you about Sydney's rainfall from July 1998 to January 1999?
- (e) What does the shape of the graph tell you about Sydney's rainfall from January 2000 to July 2007?
- (f) During what period was the storage level below 1 200 000 megalitres (below 50%)?

## NAPLAN practice 5

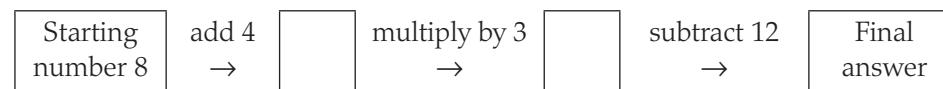
### Numeracy: Non-calculator

- 1 A number is multiplied by eight and then 5 is added. The answer is 61. What is the number?
- 2  $x$  and  $y$  stand for numbers.  $x$  and  $y$  are connected by a rule.

$x$	2	3	5	8
$y$	8	13	23	38

What is the rule?

- A  $y = 4x + 1$
  - B  $y = 5x - 2$
  - C  $y = 4x$
  - D  $y = 10x - 27$
- 3 Ting Li followed this rule. She started with 8.



- (a) What is the correct final answer using Ting Li's starting number of 8?
- (b) Alex followed the same rule using a different starting number.

Alex's starting number is -2. What was his final answer?

## Numeracy: Calculator allowed

- 4 Ethan followed a different rule to Ting Li. There were three steps. Ethan started with the number 21 and ended up with a final answer of 30.



- (a) Write the numbers from 1 to 3 on the lines below to show an order of steps that Ethan followed.

Step \_\_\_\_\_ add 8

Step \_\_\_\_\_ divide by 3

Step \_\_\_\_\_ double the number

- (b) Repeat the procedure in part (a) to get a final answer of 22.

- 5 A pack of 10 lollipops costs \$4.60.

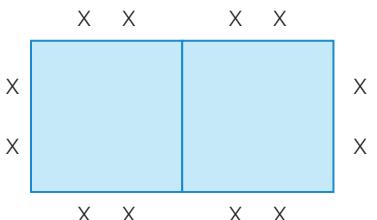
A pack of 6 costs \$3.20.

You need to buy 22 lollipops.

What is the least amount you can pay?

- 6 Yusef investigated the seating plan for a restaurant using this table of values.

Number of tables	2	3	4	5
Number of people seated	12	16	20	?



The diagram shows the seating arrangement for 2 tables.

What rule did Yusef use to work out how many people can be seated at 5 tables?

- A number of people seated = number of tables
- B number of people seated = number of tables + 4
- C number of people seated = number of tables  $\times$  6 - 1
- D number of people seated = number of tables  $\times$  4 + 4