

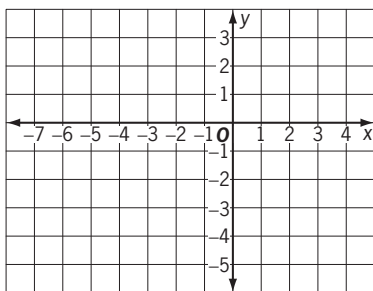
23. [Graphs & Functions]

Skill 23.1 Describing the position of ordered pairs on a coordinate plane.

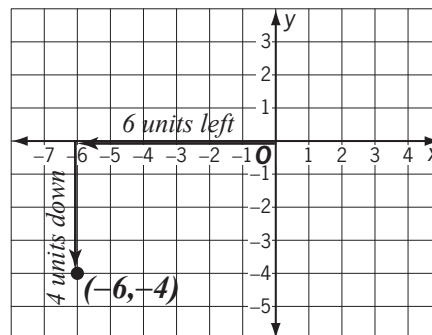
MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Start at the origin (0,0).
- Move left or right by the number of given units. This first number becomes the x -coordinate. Use a “+” sign if you moved to the right and use a “-” if you moved to the left.
- From that point, move up or down by the number of given units. This second number becomes the y -coordinate. Use a “+” sign if you moved up and use a “-” if you moved down.
- Plot the final point on the coordinate plane.

Q. Start at the origin. Move 6 units to the left along the x -axis and then down 4 units. Graph a point. What are the coordinates of the point?



A.

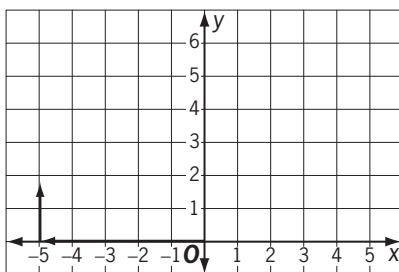


The first coordinate is -6 (6 units left)

The second coordinate is -4 (4 units down)

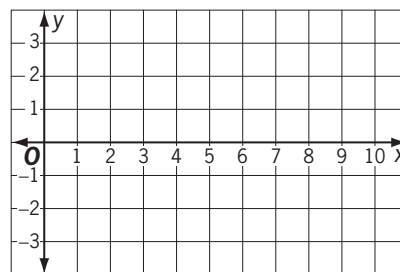
The answer is $(-6, -4)$

a) Start at the origin. Move 5 units to the left along the x -axis and then up 2 units. Graph a point. What are the coordinates of the point?



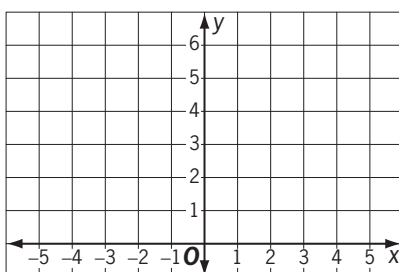
(,)

b) Start at the origin. Move 10 units to the right along the x -axis and then down 3 units. Graph a point. What are the coordinates of the point?



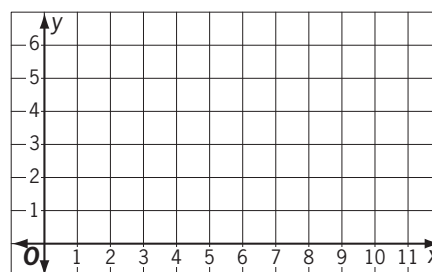
(,)

c) Start at the origin. Move 4 units to the left along the x -axis and then up 5 units. Graph a point. What are the coordinates of the point?



(,)

d) Start at the origin. Move 11 units to the right along the x -axis and then up 6 units. Graph a point. What are the coordinates of the point?



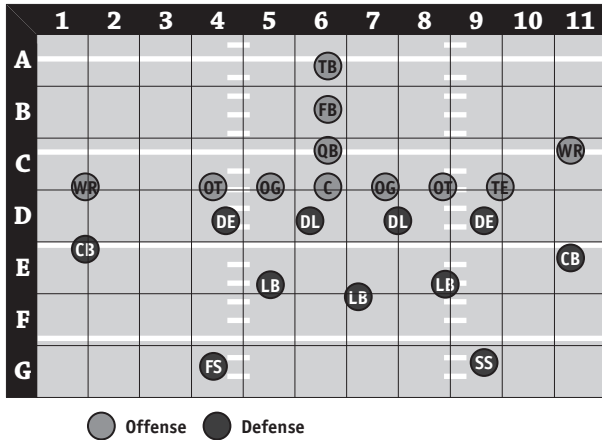
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Skill 23.2 Using grid references to describe location on a map (1).

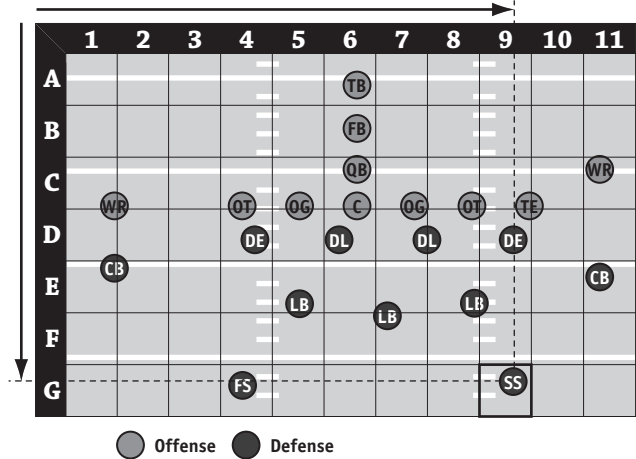
MMBlue 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Locate the object on the grid.
- Starting from the corner of the grid, first read across the horizontal axis to find the number that matches the column of the object.
- Then read along the vertical axis to find the letter that matches the row of the object.
- Write the number followed by the letter to specify the grid reference.

Q. In this starting line up, what is the grid reference of the Strong Safety (SS)?



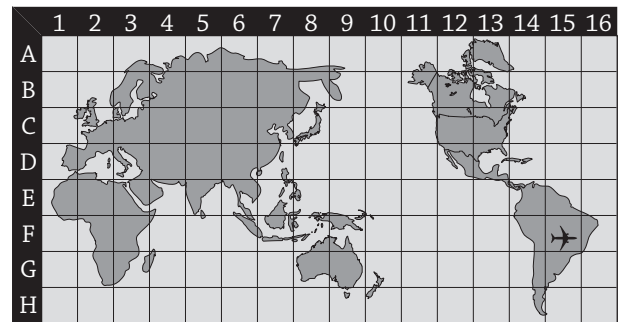
A. The grid reference is **9G**.



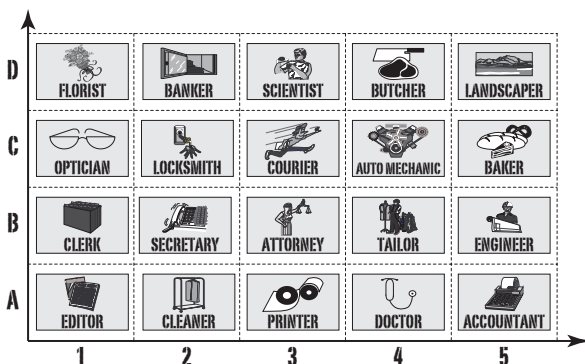
a) In which country would you be in if you were located at 1D?



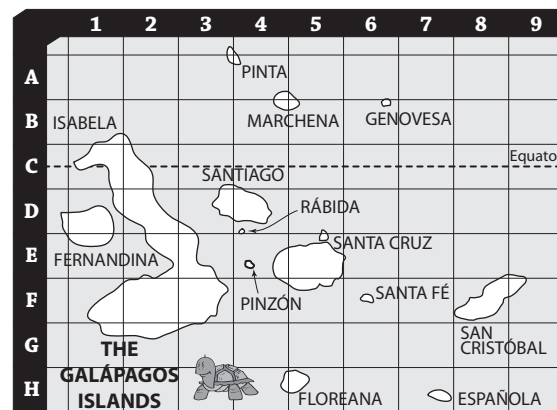
b) Above what continent would you be if your airplane is flying at 15F?



c) Which occupation is listed at 3D?



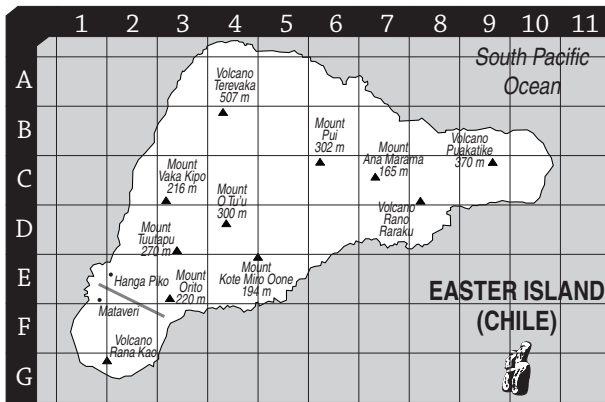
d) On which island would you be in if you were located at 7H?



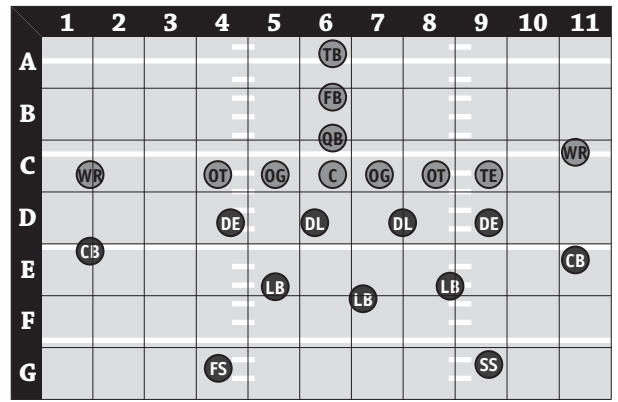
Skill 23.2 Using grid references to describe location on a map (2).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

e) On which mountain would you be if you were located at 3E?

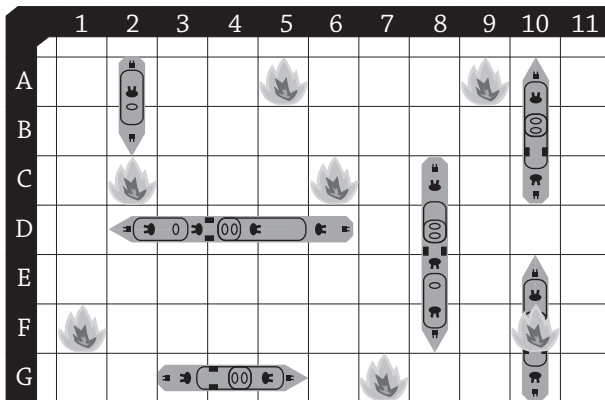


f) In this starting line up, what is the grid reference of the Tight End (TE)?



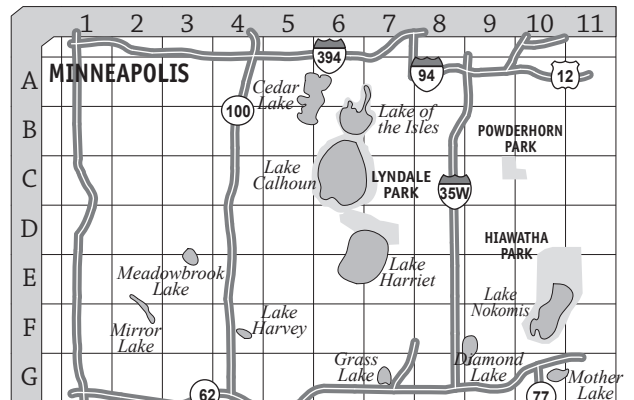
● Offense
● Defense

g) What is the grid reference of an enemy hit on a battleship?

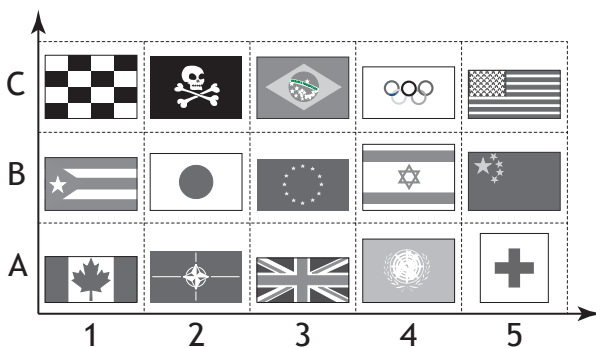


🔥 Enemy hit
🚢 Battleship

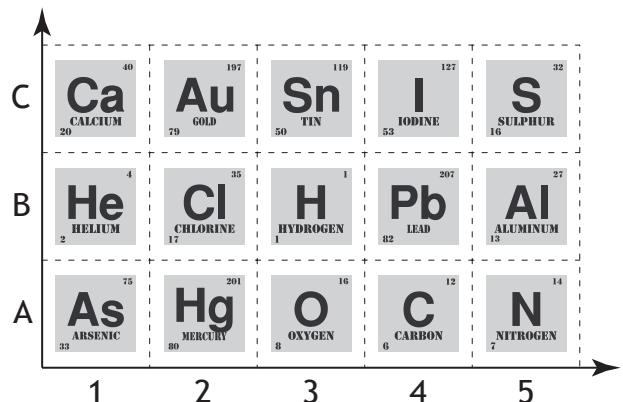
h) What is the grid reference of Grass Lake?



i) What is the grid reference of the American flag?



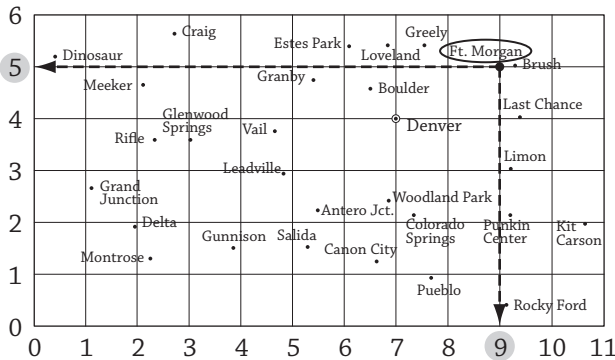
j) What is the grid reference of hydrogen?



- Locate the object on the grid.
- Move vertically from the object until you intersect the horizontal axis (x-axis).
- Write the number you find on the horizontal axis as the x-coordinate of the point (x,).
- Move horizontally from the object until you intersect the vertical axis (y-axis).
- Write the number you find on the vertical axis as the y-coordinate of the point (,y).
- Read the coordinate on the horizontal axis first, then on the vertical axis.

Hint: *x* before *y* in the alphabet is one way to remember this order.

Q. What are the coordinates of Fort Morgan?



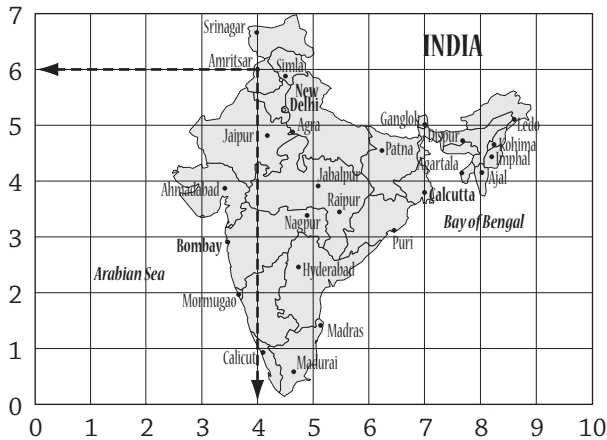
A. Locate Fort Morgan on the map.

Follow the vertical grid line that Ft Morgan is on, down to where it meets the horizontal axis. The x-coordinate is 9.

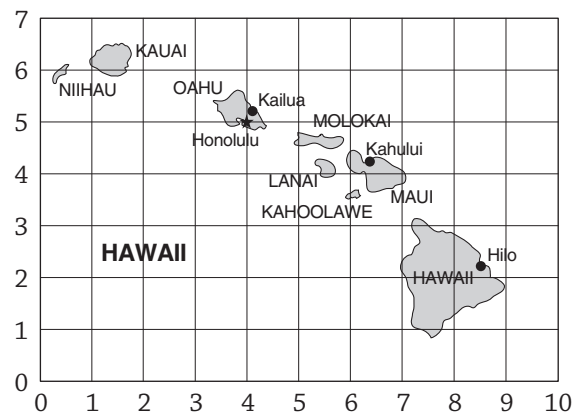
Follow the horizontal grid line that Ft Morgan is on, back to where it meets the vertical axis. The y-coordinate is 5.

The coordinates that describe the location of Ft Morgan are **(9,5)**.

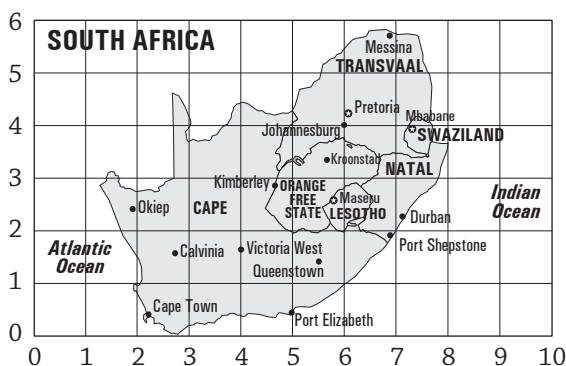
a) What are the coordinates of Amritsar?



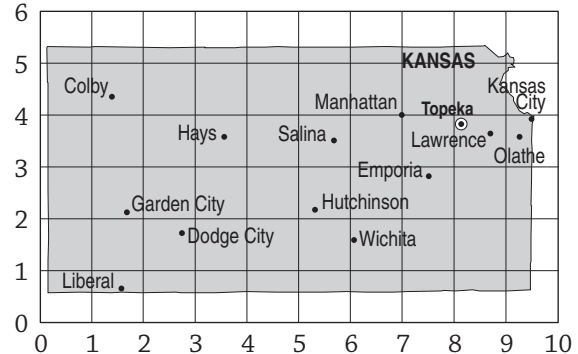
b) What are the coordinates of Honolulu?



c) What are the coordinates of Johannesburg?



d) What are the coordinates of Manhattan?



Skill 23.4 Finding the coordinates of a point on a coordinate plane (1).

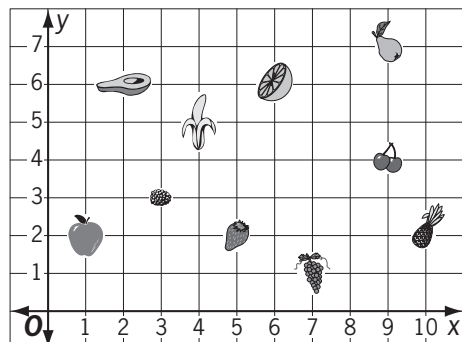
MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Locate the point on the coordinate plane.
- Move vertically from the object until you intersect the horizontal axis (x-axis).
- Write the number you find on the horizontal axis as the x-coordinate of the point (x,).
- Move horizontally from the object until you intersect the vertical axis (y-axis).
- Write the number you find on the vertical axis as the y-coordinate of the point (, y).

Hints: Always write the x-coordinate first.

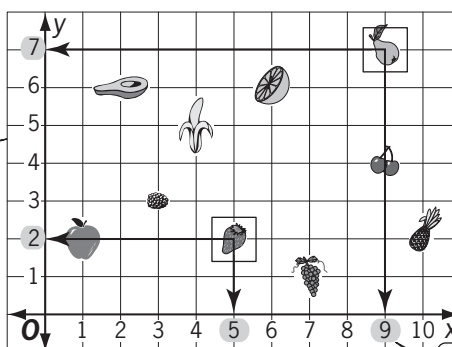
The coordinates of the origin 0 are (0,0).

Q. What are the coordinates of the pear and the strawberry?



coordinate plane

A.



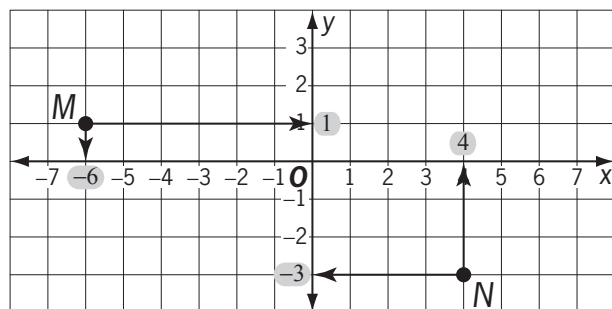
pear (9, 7)

strawberry (5, 2)

write horizontal coordinate first

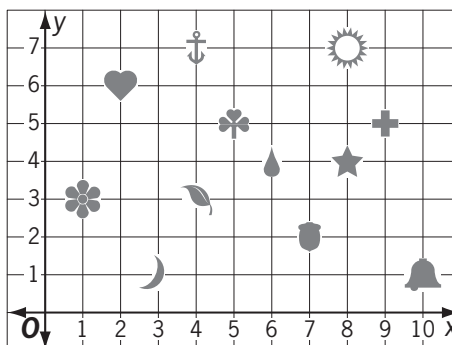
Read as: pear of coordinates 9 and 7

a) What are the coordinates of the points *M* and *N* on this coordinate plane?



$M(-6, 1)$ $N(4, -3)$

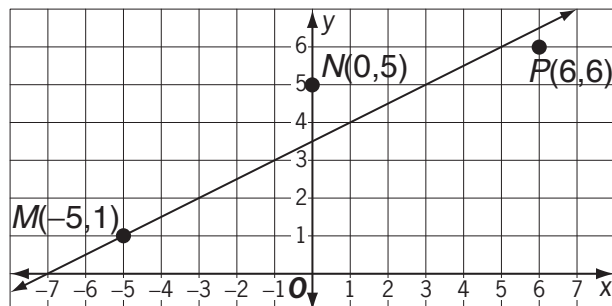
b) What are the coordinates of the sun and the moon?



sun = (8, 7) moon = (3, 1)

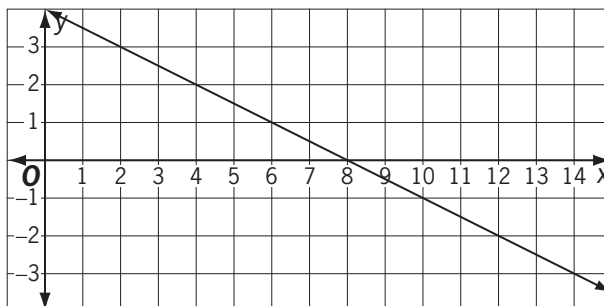
c) Which point lies on the line graphed below?

$M(-5, 1)$ $N(0, 5)$ $P(6, 6)$



d) Which point lies on the line graphed below?

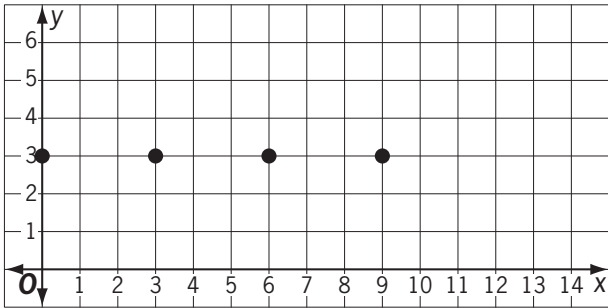
$E(4, -3)$ $F(3, 3)$ $G(12, -2)$ $H(0, 3)$



Skill 23.4 Finding the coordinates of a point on a coordinate plane (2).

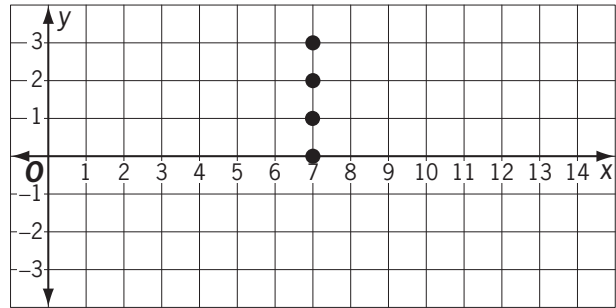
MMBlue 1 2 3 4 4
MMGreen 1 2 3 3 4 4

- e) These dots, if joined, would form a line. A point on this line has an x -coordinate of 12. What is the y -coordinate of this point?



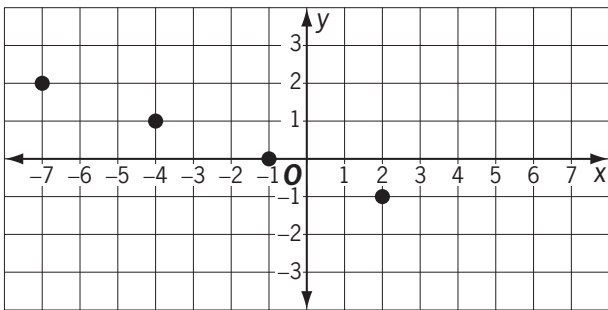
(12,)

- f) These dots, if joined, would form a line. A point on this line has a y -coordinate of -1 . What is the x -coordinate of this point?



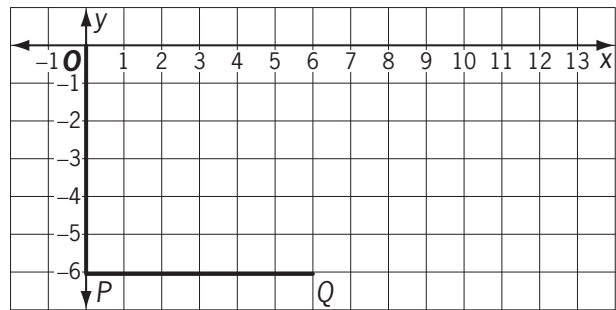
(, -1)

- g) These dots, if joined, would form a line. A point on this line has an x -coordinate of 5. What is the y -coordinate of this point?

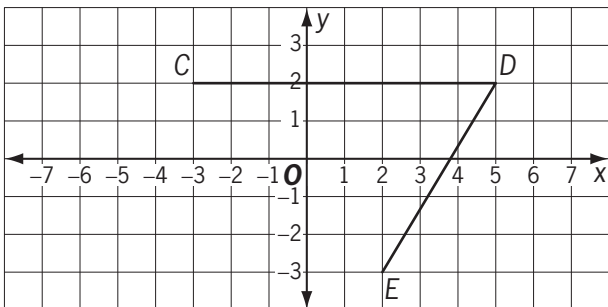


(5,)

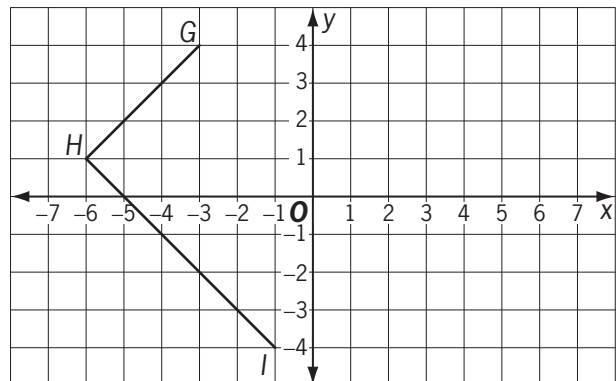
- h) What are the coordinates of point R that will make $OPQR$ a square?



- i) What are the coordinates of point F that will make $CDEF$ a parallelogram?



- j) What are the coordinates of point J that will make $GHIJ$ a rectangle?

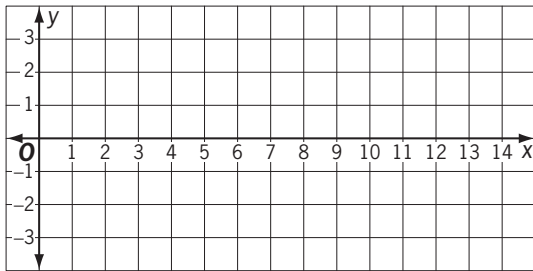


Skill 23.5 Graphing ordered pairs on a coordinate plane.

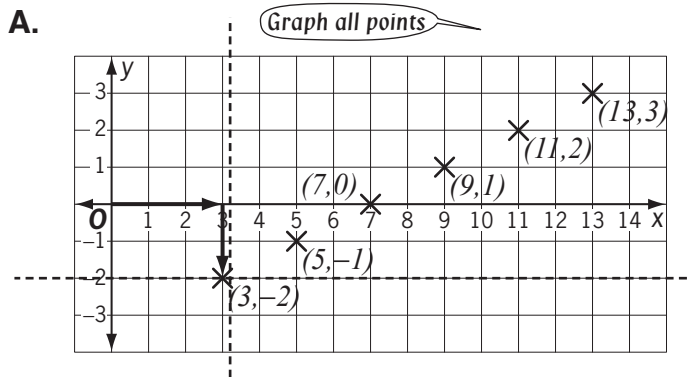
MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Start at the origin (0,0) of the coordinate plane.
- Move across the horizontal axis, or x-axis by the number of units equal to the first coordinate (move to the right if the coordinate is positive and to the left if the coordinate is negative).
- Draw a vertical line passing through this point.
- From the origin, move along the vertical axis, or y-axis by the number of units equal to the second coordinate (move up if the coordinate is positive and down if the coordinate is negative).
- Draw a horizontal line passing through this point.
- Mark the point at the intersection of these two lines.

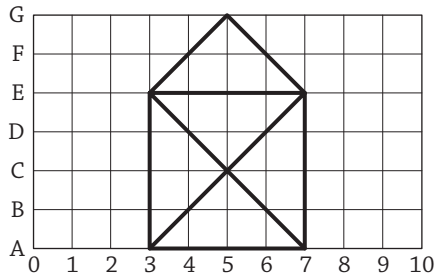
Q. Draw crosses at the following points:
(3,-2), (5,-1), (7,0), (9,1), (11,2), (13,3)



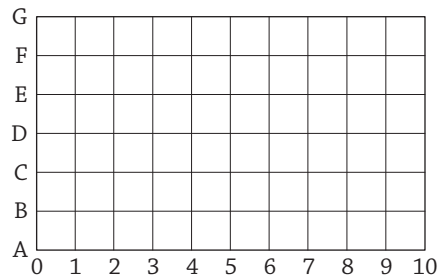
A.



a) Starting at 7A, draw a line to 7E then continue to 3E, 3A, 7A, 3E, 5G, 7E and 3A. What shape have you drawn?

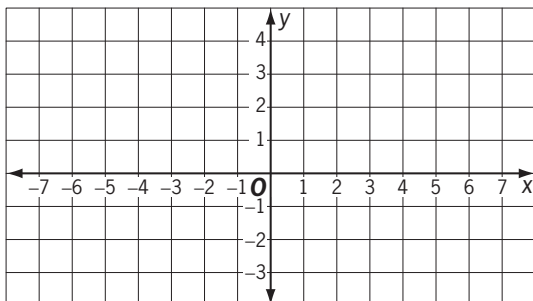


b) Starting at 4E, draw a line to 4F then continue to 9F, 9E, 7E, 7A, 6A, 6E and 4E. What letter have you drawn?



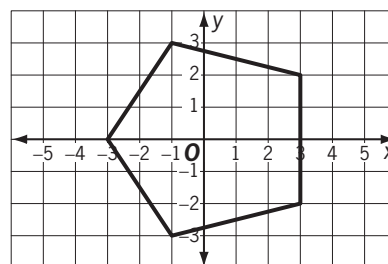
c) Graph the following points on this coordinate plane:

P at coordinates (-5,3)
Q at coordinates (-4,-1)
R at coordinates (3,-2)



d) Which set of ordered pairs lie within this pentagon?

- A) (3,3), (-2,-2)
B) (-2,1), (2,-1)
C) (1,-3), (-4,2)



Skill 23.6 Writing linear expressions to represent real-life situations (1).MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Use addition to represent a total or a sum.
- Use subtraction to represent a difference or a remainder.
- Use multiplication to represent a quantity which is a number of times greater or smaller than another quantity.
- Simplify the expression.

Q. A school canteen sells cups of soup for \$2.50 and sandwiches for \$3. Which expression represents the cost of 4 cups of soup and 5 sandwiches?

- A) $4(2.5 + 3)$
 B) $4 \cdot 2.5 + 5 \cdot 3$
 C) $5(2.5 + 3)$

A. 4 cups of soup @ \$2.50 each $\Rightarrow 4 \cdot 2.5$
 5 sandwiches @ \$3.00 each $\Rightarrow 5 \cdot 3$
 \Rightarrow total cost is $4 \cdot 2.5 + 5 \cdot 3$
 The answer is **B**.

a) A printer can print 20 pages per minute. Which expression represents the total number of pages printed in 6 minutes?

- A) $6 \cdot 20$
 B) $6 + 20$
 C) $20 \div 6$

total pages = $6 \cdot 20$

\Rightarrow

b) Suzzie bought a bike for \$90, and then sold it for \$30 less. Which expression represents the selling price?

- A) $90 + 30$
 B) $90 \div 30$
 C) $90 - 30$

selling price =

\Rightarrow

c) A Boeing 747 can fly 570 miles per hour. Which expression represents the distance traveled in 5 hours?

- A) $570 + 5$
 B) $570 \cdot 5$
 C) $570 \cdot 747$

distance =

\Rightarrow

d) A bike can travel 15 miles per hour. Which expression represents the time, in hours, taken to travel 3 miles?

- A) $15 \div 3$
 B) $3 \div 15$
 C) $15 \cdot 3$

time =

\Rightarrow

e) To send a fax it costs \$6 for the first page, and then \$2 for each of the following pages. Which expression represents the total cost to send a 5-page fax?

- A) $6 + 2 \cdot 5$
 B) $(6 + 2) \cdot 5$
 C) $6 + 2 \cdot 4$

cost first page = \$6

cost remaining pages = $\$2 \cdot 4$

total cost = $6 + 2 \cdot 4$

\Rightarrow

f) The first 2 minutes of a phone call cost \$3, and then each minute costs 40 cents. Which expression represents the total cost of a 7 minute call?

- A) $3 \cdot 2 + 0.4 \cdot 5$
 B) $3 + 0.4 \cdot 5$
 C) $3 + 40 \cdot 5$

cost first 2 min =

cost remaining minutes =

total cost =

\Rightarrow

Skill 23.6 Writing linear expressions to represent real-life situations (2).

MMBlue 11 22 3 44
MMGreen 11 22 3 44

g) Aquatic Center Tickets

type of ticket	price (\$)
adult	6
child (4 - 15)	4
student	5
pensioner	5

Which expression represents the total cost for 3 adults and 2 children aged six?

- A) $6 \cdot 3 + 4 \cdot 2$
- B) $(6 + 4) \cdot 3$
- C) $(6 + 4) \cdot 2$

cost adult tickets = _____
 cost child tickets = _____
 total cost = _____ \Rightarrow

h) A bus company spends \$30 per hour to run a bus. Fifty students paid \$10 each to travel by bus. If the excursion lasted 6 hours, which expression represents the profit made by the bus company?

- A) $10 \cdot 50 \cdot 6 - 30$
- B) $10 \cdot 50 + 30 \cdot 6$
- C) $10 \cdot 50 - 30 \cdot 6$

profit = _____ \Rightarrow

i) Population - July 2009

continent	population (millions)
The Americas & the Caribbean	915
Europe	736
Asia	4052
Oceania	x

Which expression represents the total population living in these four continents?

- A) $915 + 736 + 4052 + 4x$
- B) $915 + 736 + 4052 + x$
- C) $915 + 736 + 4052 - x$

total population = _____ \Rightarrow

j) Space Shuttle Missions up to August 2009

shuttle	missions
Columbia	28
Challenger	10
Endeavour	25
Discovery	39
Atlantis	x

Which expression represents the total number of missions flown by all shuttles?

- A) $127 + x$
- B) $102 + x$
- C) $102 - x$

total missions = _____ \Rightarrow

k) Donna has x nickels and y dimes in her bag. Which expression represents the total amount in cents she has in her bag?

- A) $5(x + y)$
- B) $10(x + y)$
- C) $5x + 10y$

_____ \Rightarrow

l) Nico drove x miles, and Mia drove y miles. If Nico drove z miles more than Mia, which equation expresses this?

- A) $x = y + z$
- B) $y = x + z$
- C) $z = x + y$

_____ \Rightarrow

Skill 23.7 Interpreting distance-time graphs and other linear graphs (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

To find the time taken to travel when the distance is given:

- Locate the point on the vertical axis, marking the given distance.
- Draw a horizontal line through that point.
- Locate the intersection between this horizontal line and the graph.
- Draw a vertical line through the intersection point until it intersects the horizontal axis.
- Mark and read the value of the time on the horizontal axis at the intersection point.

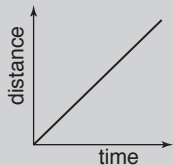
To find the distance traveled:

- Measure the value on the vertical axis, starting from the origin of the axes.

To interpret distance-time graphs:

Object moving at a constant rate

It covers the same distance in the same time interval.



Object not moving

Time increasing, but distance not changing.

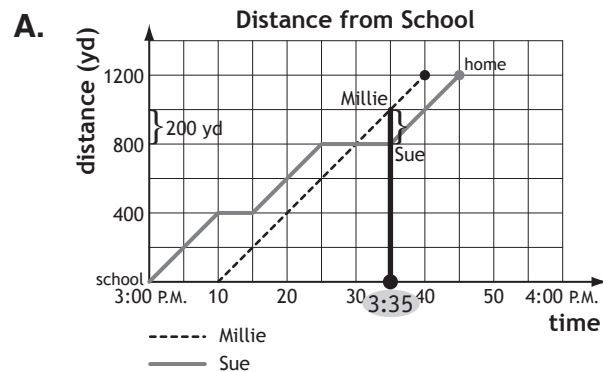
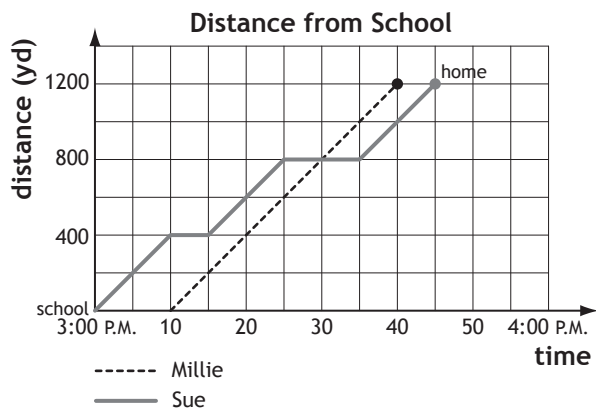


Object moving at a changing rate

At first it travels at a faster rate and then it travels at a gradually slower rate.

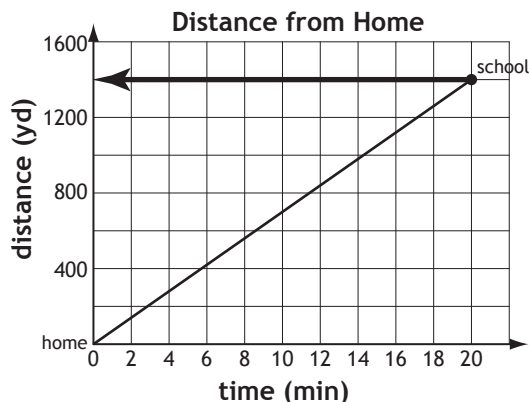


Q. Millie and Sue walk home, leaving school 10 minutes apart. What is the distance between them at 3:35 P.M.?



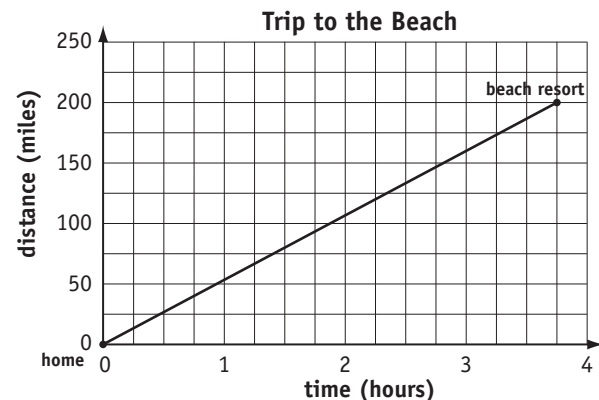
Sue reached 800 yd at 3:35 P.M.
Millie reached 1000 yd at 3:35 P.M.
distance between girls = 1000 yd – 800 yd
= 200 yd

a) This graph shows Grace’s distance from home as she walks to school. How far is the school from home?



distance = yd

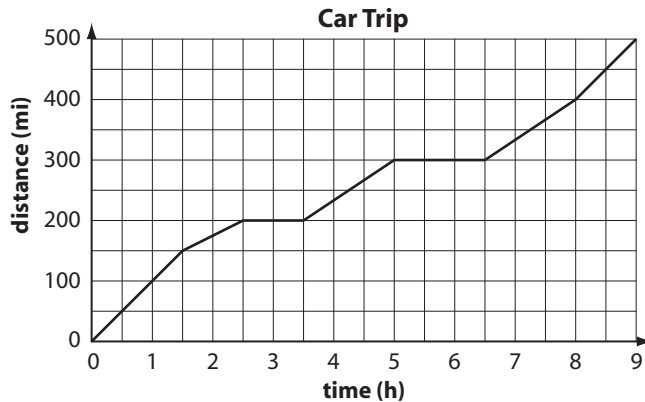
b) Chloe leaves home at 1:00 P.M. At what time does she arrive at the beach resort?



time =

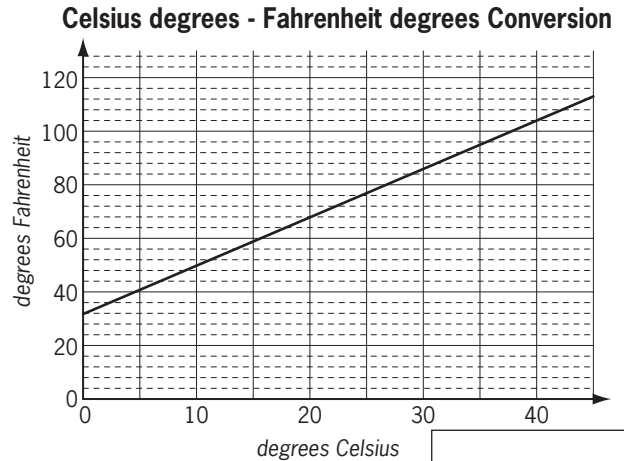
Skill 23.7 Interpreting distance-time graphs and other linear graphs (2).

c) This graph shows the distance traveled by a car over a 9-hour period. For how long does the car stop in total?

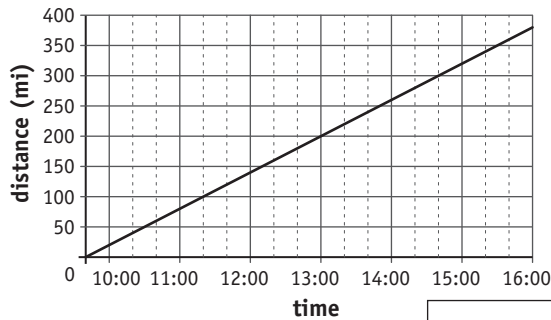


h

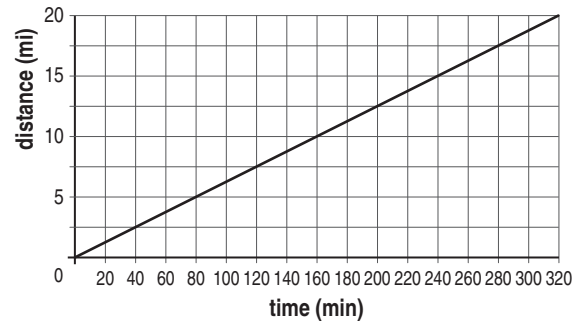
d) Approximately how many degrees Celsius are equivalent to 104 degrees Fahrenheit?



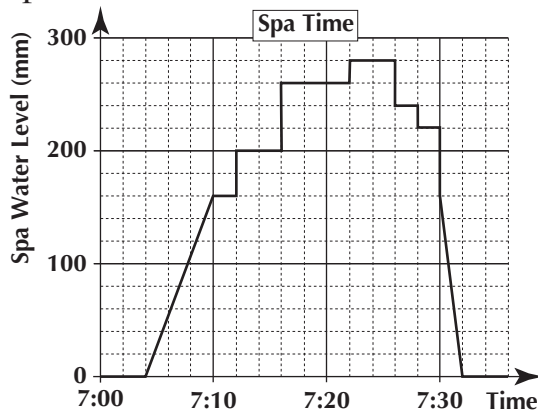
e) This graph shows the distance Felix traveled between 9:40 A.M. and 4:00 P.M. How long in minutes did the car take to travel 200 miles?



f) This graph shows the distance run by Josh at constant speed. How many miles did he cover in 4 hours?

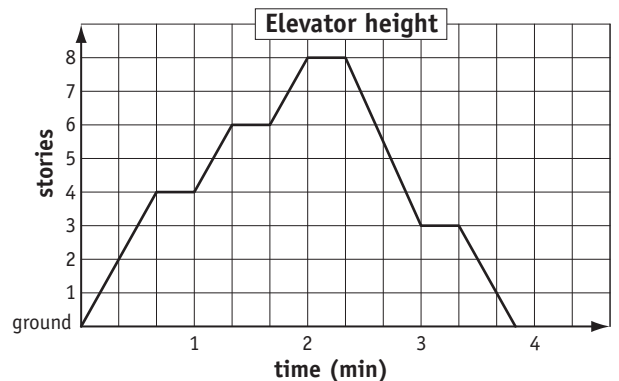


g) At 7:12 Caitlin got into the spa, followed later by Emma and then her younger sister. For how long was Emma in the spa?



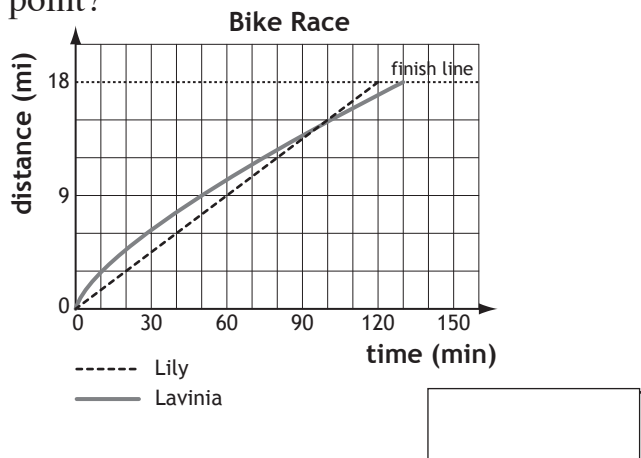
min

h) This graph shows the height of an elevator in an eight-story building. How many times does the elevator stop on its way to the top?

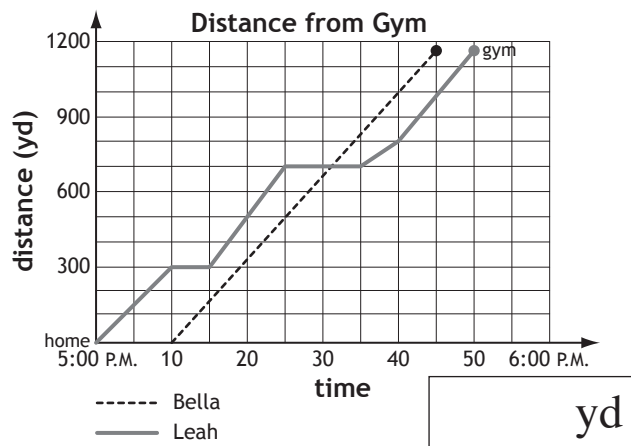


Skill 23.7 Interpreting distance-time graphs and other linear graphs (3).

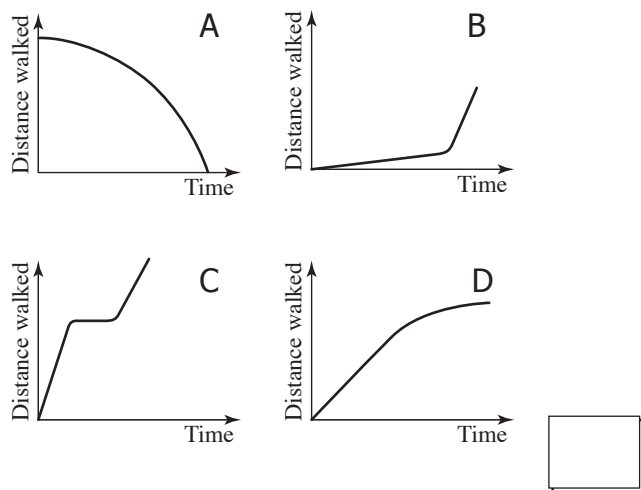
- i) Lily and Lavinia have an 18-mile bike race. Who was winning at the half way point?



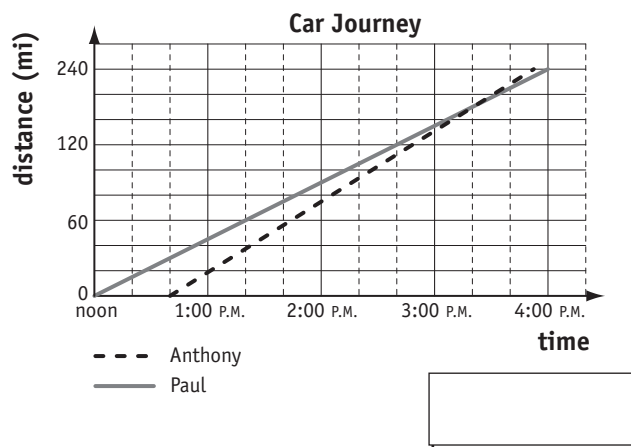
- j) Bella and Leah walk to the gym, leaving home 10 minutes apart. What is the distance between them at 5:40 P.M.?



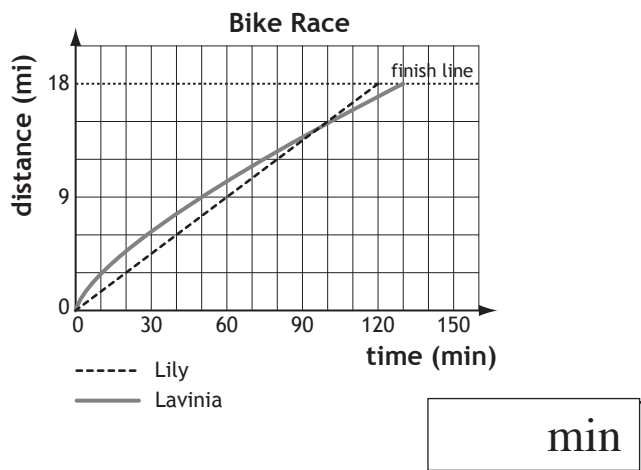
- k) Which graph would best describe Jo's walk if she walked quickly at first and then gradually decreased her speed?



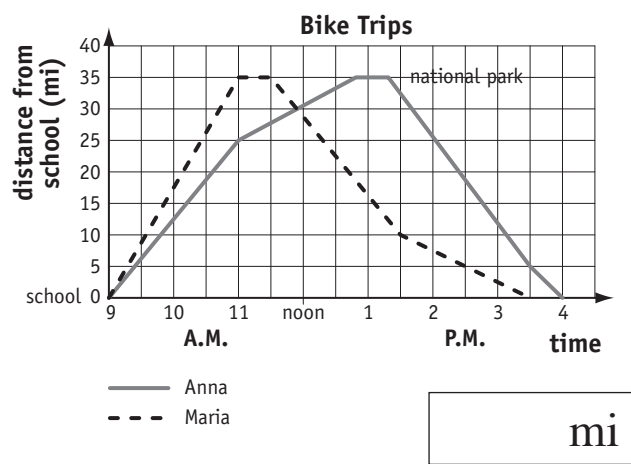
- l) The graph shows the distance traveled by Paul and Anthony by car, on the same journey. At what time does Anthony's car overtake Paul's?



- m) Lily and Lavinia have a bike race. How much longer does Lavinia take to complete the second 9 miles than the first 9 miles?



- n) The graph shows the bike trips of Anna and Maria, from their school to the national park and back. How far from the park do they meet?



Skill 23.8 Completing a table of values for a linear function (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Substitute the variable x with the given values.
- Calculate the values of y .

Q. Complete the table of values for the function rule $y = -2 + x$

x	$-2 + x$	y
0	$-2 + 0 = -2$	-2
1		
2		
3		
4		
5		

A. $y = -2 + x$ Substitute $x = 1$
 $x = 1 \Rightarrow y = -2 + 1 = -1$
 $x = 2 \Rightarrow y = -2 + 2 = 0$
 $x = 3 \Rightarrow y = -2 + 3 = 1$
 $x = 4 \Rightarrow y = -2 + 4 = 2$
 $x = 5 \Rightarrow y = -2 + 5 = 3$

\Rightarrow

x	$-2 + x$	y
0	$-2 + 0 = -2$	-2
1	$-2 + 1 = -1$	-1
2	$-2 + 2 = 0$	0
3	$-2 + 3 = 1$	1
4	$-2 + 4 = 2$	2
5	$-2 + 5 = 3$	3

a) Complete the function table:

Houses sold (x)	Earnings ($2000x$)
1	$2000 \cdot 1 = 2000$
2	$2000 \cdot 2 = 4000$
3	$2000 \cdot 3 = 6000$
4	
5	
6	

b) Complete the function table:

Number of guests (x)	Dinner cost in dollars ($15x$)
4	$15 \cdot 4 = 60$
8	
12	
16	
20	
24	

c) Complete the function table:

No. of days (x)	Records entered ($90x$)
1	$90 \cdot 1 = 90$
2	
3	
4	
5	
6	

d) Complete the function table:

No. of days (x)	Number of T-shirts sold ($16x$)
1	$16 \cdot 1 = 16$
2	
3	
4	
5	
6	

e) Complete the function table:

No. of hours worked (x)	Pay in dollars ($8x$)
2	$8 \cdot 2 = 16$
4	
6	
8	
10	
12	

f) Complete the function table:

No. of seconds (x)	Distance traveled in yards ($18x$)
10	$18 \cdot 10 = 180$
20	
30	
40	
50	
60	

Skill 23.8 Completing a table of values for a linear function (2).MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- g)** Complete the table of values for the function rule $y = x + 5$

x	$x + 5$	y
0	$0 + 5 = 5$	5
1		
2		
3		
4		
5		

- h)** Complete the table of values for the function rule $y = 8 - x$

x	$8 - x$	y
3	$8 - 3 = 5$	5
4		
5		
6		
7		
8		

- i)** Complete the table of values for the function rule $y = 7 + x$

x	$7 + x$	y
0	$7 + 0 = 7$	7
2		
4		
6		
8		
10		

- j)** Complete the table of values for the function rule $y = x - 4$

x	$x - 4$	y
0	$0 - 4 = -4$	-4
1		
2		
3		
4		
5		

- k)** Complete the table of values for the function rule $y = 3x$

x	$3x$	y
0	$3 \cdot 0 = 0$	0
1		
2		
3		
4		
5		

- l)** Complete the table of values for the function rule $y = x - 6$

x	$x - 6$	y
1	$1 - 6 = -5$	-5
2		
3		
4		
5		
6		

- m)** Complete the table of values for the function rule $y = 100 \div x$

x	$100 \div x$	y
5	$100 \div 5 = 20$	20
10		
20		
25		
50		
100		

- n)** Complete the table of values for the function rule $y = 2 - x$

x	$2 - x$	y
0	$2 - 0 = 2$	2
1		
2		
3		
4		
5		

Skill 23.9 Graphing linear functions on a coordinate plane (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

To determine the correct equation of a given line:

EITHER

- Choose two points lying on the linear graph.
- Substitute the coordinates of these points in the equation of the line.
- Check if they are both true statements.

OR

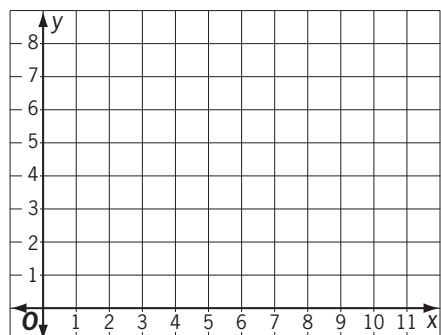
- Check for special properties of the x - or the y -coordinates.

Example: All the points where $x = 4$ means that all points are lying on a vertical line passing through the point $(4,0)$.

To draw the graph of a given equation:

- Choose two different pairs of numbers (x,y) which satisfy the equation.
- Plot these two pairs of coordinates.
- Join the points.

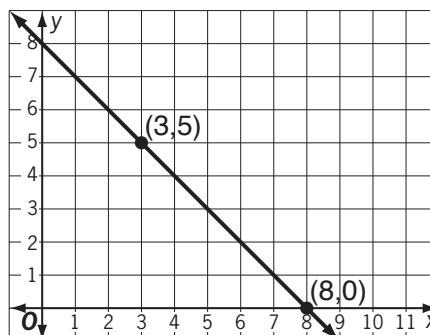
Q. Draw the line through all the points where the x -coordinate and the y -coordinate add to 8.



A. $x + y = 8$

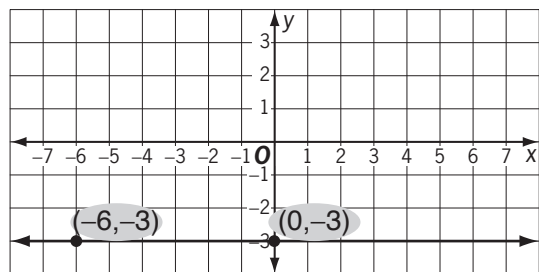
Choose $x = 8$ and $y = 0 \Rightarrow$ the point $(8,0)$

Choose $x = 3$ and $y = 5 \Rightarrow$ the point $(3,5)$



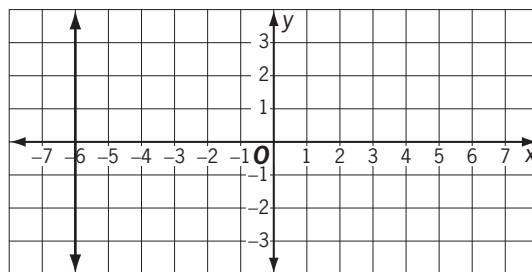
a) This line is best described as:

- A) All points where $x - y = 3$
- B) All points where $x = -3$
- C) All points where $y = -3$



b) This line is best described as:

- A) All points where $y - x = 6$
- B) All points where $x = -6$
- C) All points where $y = -6$



$x - y = 3$ A) $0 - (-3) = 3$ or $3 = 3$ (true) $x = 0$ and $y = -3$

$-3 - (-3) = 3$ or $0 = 3$ (false) $x = -6$ and $y = -3$

$x = -3$ B) $0 = -3$ (false) and $-6 = -3$ (false)

$y = -3$ C) $-3 = -3$ (true)

$-3 = -3$ (true) \Rightarrow

A)

B)

C)

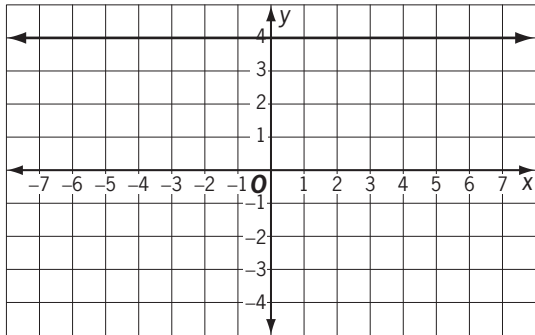
\Rightarrow

Skill 23.9 Graphing linear functions on a coordinate plane (2).

MMBlue 11 22 33 44
MMGreen 11 22 33 44

c) This line is best described as:

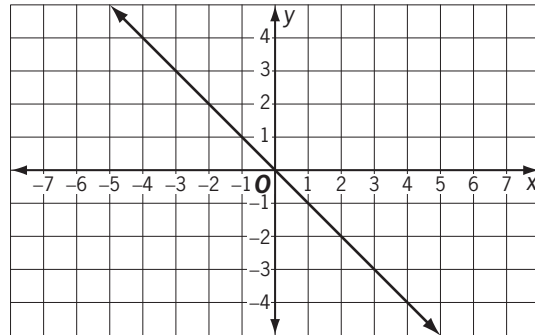
- A) All points where $y = 4$
 B) All points where $x = 4$
 C) All points where $x + y = 4$



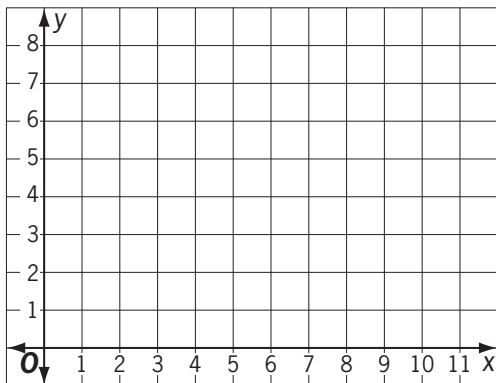
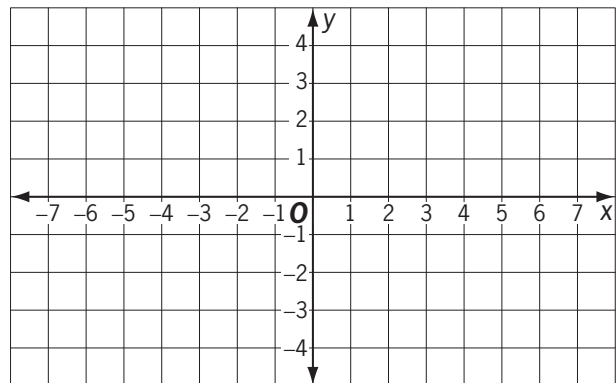
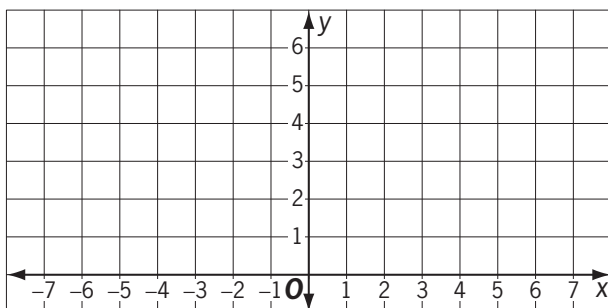
⇒

d) This line is best described as:

- A) All points where $x = 0$
 B) All points where $y = -x$
 C) All points where $y = 0$



⇒

e) Draw the line through all the points where the x -coordinate and the y -coordinate add to 10.f) Draw the line through all the points where the x -coordinate and the y -coordinate add to 1.g) Draw the line through all the points where the y -coordinate is 4 more than the x -coordinate.h) Draw the line through all the points where the x -coordinate is 3 more than the y -coordinate.