



KING EDWARD VI
HANDSWORTH GRAMMAR
SCHOOL FOR BOYS



KING EDWARD VI
ACADEMY TRUST
BIRMINGHAM

Year 9

2025 Mathematics 2026

Unit 14 Student – Part 1

HGS Maths



Tasks



Dr Frost Course



Name: _____

Class: _____



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Unit 14 Student – Part 2

HGS Maths



Tasks



Dr Frost Course



Name: _____

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1 Linear Inequalities

Worked Example

Represent on a number line:

a) $x > -1$

b) $x \leq 1$

Your Turn

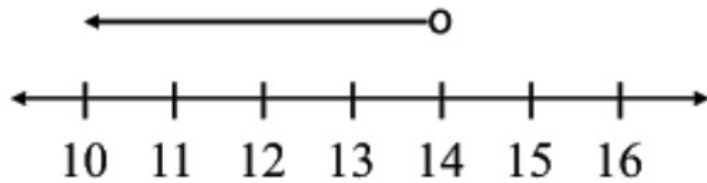
Represent on a number line:

a) $x \leq -2$

b) $x > 2$

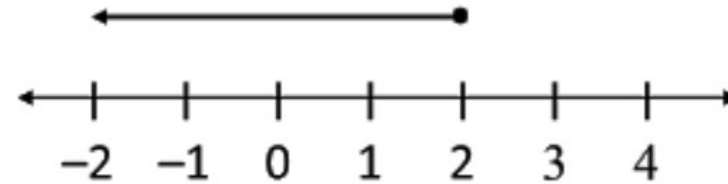
Worked Example

Write down the inequality for x shown on the number line:

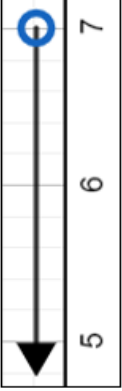


Your Turn

Write down the inequality for x shown on the number line:



Fill in the Gaps

1) x is less than 7	$x < 7$	
2) x is less than or equal to 7		
3) x is more than 4		
4) x is more than 10		
5) x is more than 3.5		
6) x is more than or equal to 7.5		
7) x is less than or equal to 0		
8) x is more than or equal to 3.5		

Worked Example

Represent on a number line:

a) $-1 < x \leq 2$

b) $-1 \leq x < 2$

Your Turn

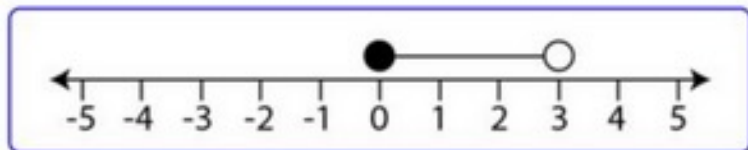
Represent on a number line:

a) $-2 \leq x < 1$

b) $-3 < x \leq 4$

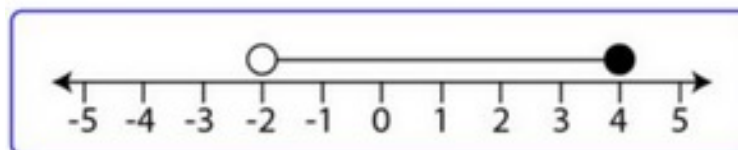
Worked Example

Write down the inequality for x shown on the number line:



Your Turn

Write down the inequality for x shown on the number line:



Worked Example

List the integers that satisfy $-4 \leq x < 5$

Your Turn

List the integers that satisfy $-7 < y \leq 2$

Worked Example

Plot $x < 3$ or $x > 7$ on a number line

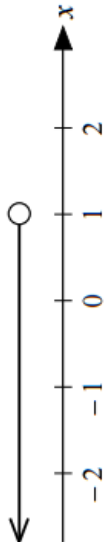
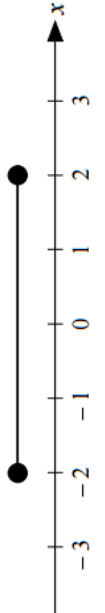
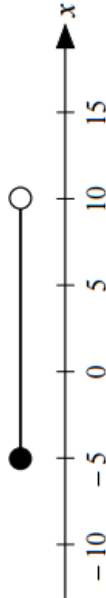
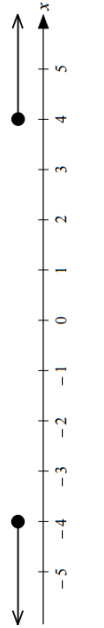
Your Turn

Plot $x \leq -3$ or $x > 5$ on a number line

Set Notation

Fill in the Gaps

Complete the table

	Number Line	Set Notation
1		
2		
3		
4		$\{x : -1 < x < 3\}$
5		$\{x : -2 < x \leq 2\}$
6		
7		$\{x : x < -3 \text{ or } x > 3\}$
8		

Worked Example

Solve $2x - 8 < 16$

Your Turn

Solve $3x - 9 > 27$

Worked Example

Solve $-8 - 3x \geq -1$

Your Turn

Solve $-6 - 5x \leq 7$

Worked Example

Solve $7(x + 3) - 3(2x - 6) \geq 84$

Your Turn

Solve $5(x - 3) - 2(2x - 6) \geq 111$

Worked Example

Solve $11 < \frac{5(2x-3)-2}{3}$

Your Turn

Solve $49 > \frac{3(4x+7)+5}{2}$

Worked Example

Work out the least integer value that satisfies the inequality:

$$9 > \frac{2(7 - 4x)}{3}$$

Your Turn

Work out the least integer value that satisfies the inequality:

$$6 \geq \frac{5(5 - 2y)}{3}$$

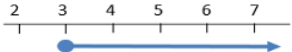
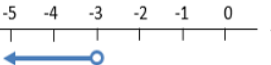
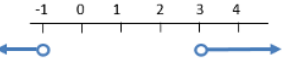
Worked Example

The width of a rectangle is a whole number of centimetres.
The length of the rectangle is 9 cm longer than the width.
The perimeter of the rectangle no more than 55 cm.
Find the greatest possible width of the rectangle.

Your Turn

- Freddie has n marbles.
Souleymane had 4 times as many marbles as Freddie, but
Souleymane has now lost 15 of them.
Souleymane still has more marbles than Freddie.
- a) Write down an inequality in terms of n to show the above information.
 - b) Use your inequality to find the least number of marbles that Freddie may have.

Fill in the Gaps

Q	<i>Inequality</i>	Represent on a number line	<i>Integer solutions</i>
1	$x > 3$		
2			$x = 3, 4, 5 \dots$
3			$x = -3, -4, -5 \dots$
4	$-3 \leq x$		
5	$x - 1 > 2$		
6			
7	$x + 5 \leq 2$		
8			
9			$x = 4, 5, 6 \dots$ or $x = -1, -2, -3 \dots$
10	$< x \leq$		$x = -2, -1, 0, 1, 2, 3$
11	$x \geq 1$ and $x < 3$		
12	$3x > 9$		

Worked Example

Solve:

a) $9x + 4 < 2x + 60$

b) $3x - 23 \leq 7 - 2x$

Your Turn

Solve:

a) $5x + 7 > 2x + 22$

b) $2x - 23 \geq 9 - 2x$

Worked Example

Solve:

a) $3(x + 2) < 2(x + 3)$

b) $3(x + 8) > 3(2 - x)$

Your Turn

Solve:

a) $7(x - 3) \leq 2(x + 7)$

b) $3(x - 5) \geq 5(5 - x)$

Worked Example

Solve: $\frac{5x-8}{3} \geq 2x + 3$

Your Turn

Solve: $\frac{2y+8}{5} \leq 3y + 1$

Worked Example

Solve: $\frac{2x+4}{5} > \frac{x-3}{2}$

Your Turn

Solve: $\frac{2a-1}{2} \geq \frac{4a+3}{5}$

Worked Example

Solve:

a) $-1 < 2x + 3 < 9$

b) $-1 \leq 2x + 6 < 9$

Your Turn

Solve:

a) $-9 < 2x + 3 < 1$

b) $-9 \leq 2x + 6 \leq 1$

Worked Example

Solve the inequality $16 \leq 4x + 18 < 40$ where x is an integer.
List all values of x

Your Turn

Solve the inequality $-14 \leq 2n - 5 \leq -2$ where n is an integer.
List all values of n

Worked Example

Solve: $8 \leq -1 + \frac{1}{2}n < 10$

Your Turn

Solve: $5 \leq \frac{-9+5x}{2} < 15$

Worked Example

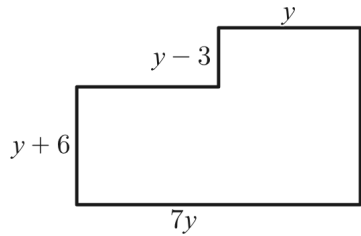
Solve: $5 < -2x + 18 \leq 17$

Your Turn

Solve: $-20 < 18 - 3n < 1$

Worked Example

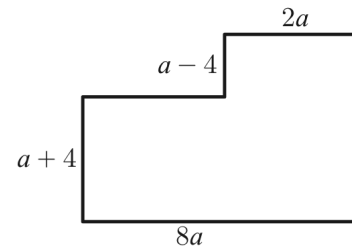
A tile is made of a rectangle of length $7y$ cm and width $(y + 6)$ cm and another rectangle of length y cm and width $(y - 3)$ cm is added to one corner as shown in the diagram.



Given that the perimeter of this tile is at least 96 cm and no more than 132 cm, determine the set of possible values of y

Your Turn

A tile is made of a rectangle of length $8a$ cm and width $(a + 4)$ cm and another rectangle of length $2a$ cm and width $(a - 4)$ cm is added to one corner as shown in the diagram.



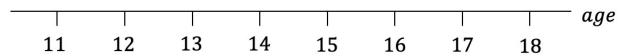
Given that the perimeter of this tile is more than 140 cm and less than 240 cm, determine the set of possible values of a

Worked Example

$$12 \leq a \leq 17$$

$$a > 15$$

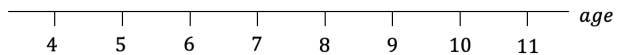
Combined



$$x \leq 6 \text{ or } x \geq 8$$

$$5 < x \leq 9$$

Combined



Your Turn

$$x \leq 8$$

$$6 \leq x < 9$$

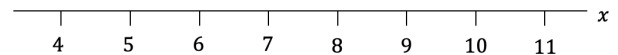
Combined



$$x \leq 6 \text{ or } x > 9$$

$$7 \leq x \leq 10$$

Combined



Worked Example

Find the set of values of x for which:

- a) $3x - 5 < x + 8$ and $5x > x - 8$
- b) $x - 5 > 1 - x$ or $15 - 3x > 5 + 2x$

Your Turn

Find the set of values of x for which:

- a) $2x + 3 < x + 7$ and $4x \geq 2x - 6$
- b) $x - 4 \leq 3x - 2$ or $-7 - 2x > 3x - 1$

Worked Example

Solve the inequalities $7 < 3x - 20$ and $3x + 16 < 58$
Write down all the integer values of x that satisfy both of the inequalities.

Your Turn

Solve the inequalities $-10 < 4n + 11$ and $3n + 12 \leq 12$
Write down all the integer values of n that satisfy both of the inequalities.

Worked Example

Solve:

$$3 - x \leq 2 < 10 - 2x$$

Your Turn

Solve:

$$1 + x < 5 \leq 7 + 5x$$

Extra Notes

2 Straight Line Graphs

Worked Example

Plot the graph of $y = 2x + 1$ for the values $-2 \leq x \leq 2$

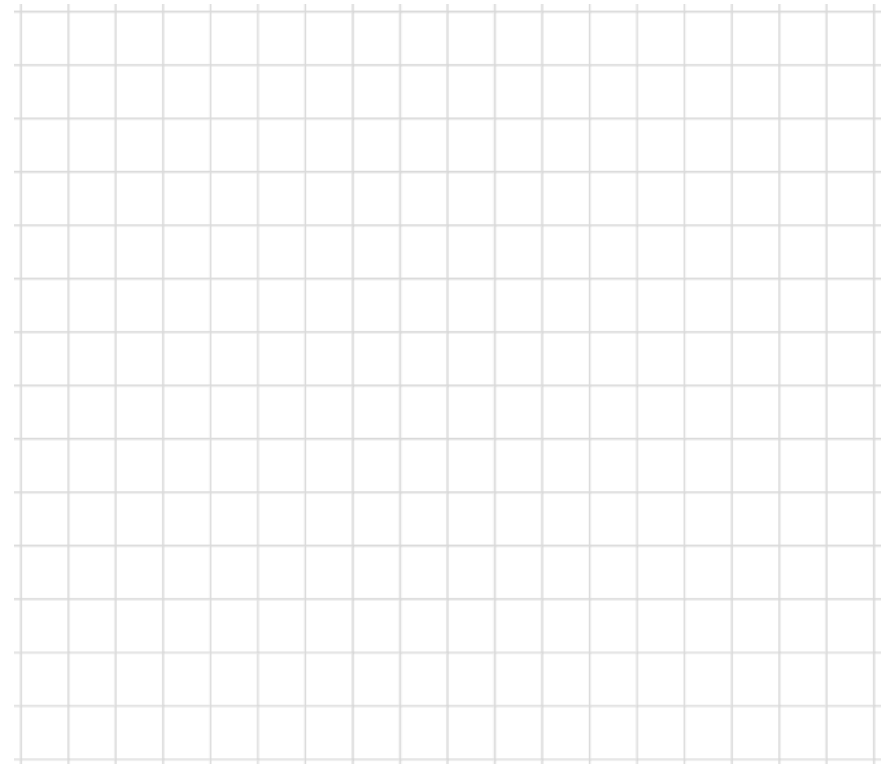
x					
y					
Coordinates					



Your Turn

Plot the graph of $y = 4x - 2$ for the values $-2 \leq x \leq 2$

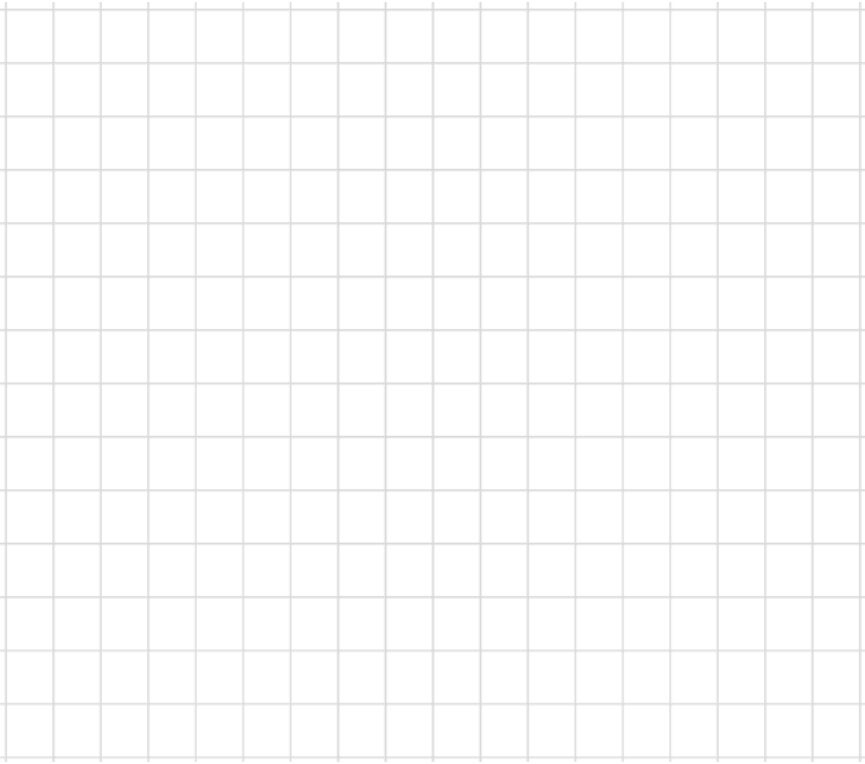
x					
y					
Coordinates					



Worked Example

Plot the graph of $y = -2x + 1$ for the values $-2 \leq x \leq 2$

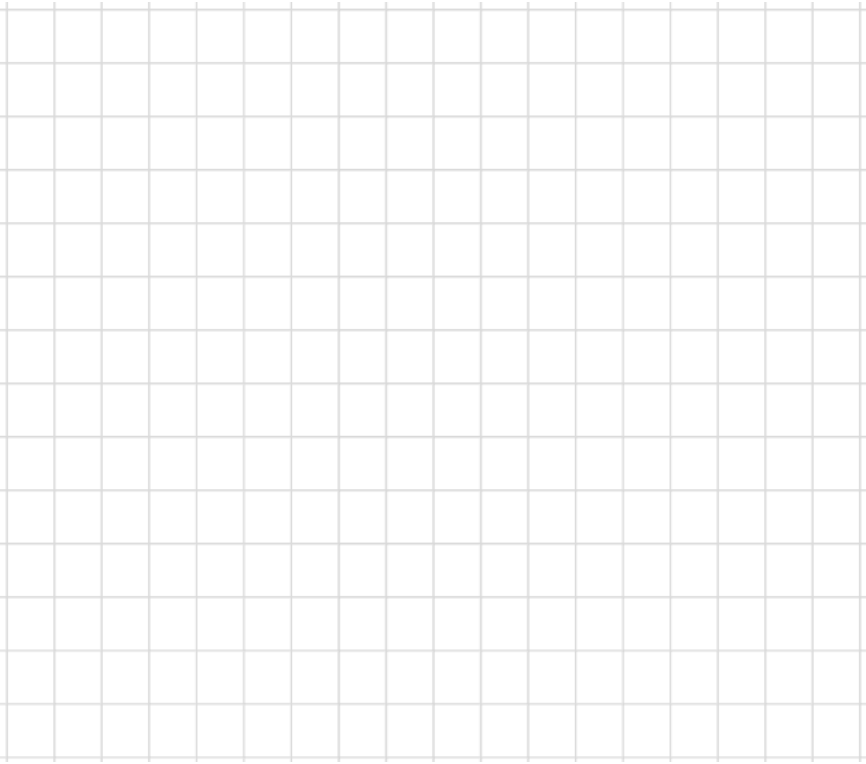
x					
y					
Coordinates					



Your Turn

Plot the graph of $y = -4x - 2$ for the values $-2 \leq x \leq 2$

x					
y					
Coordinates					



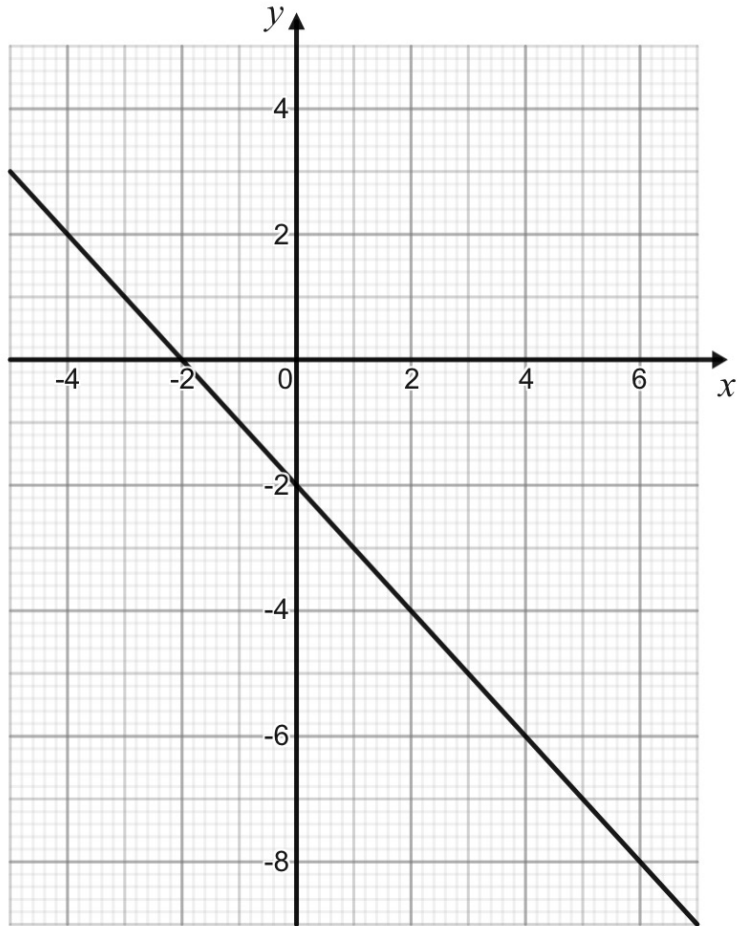
Fluency Practice

Equation	$y = x + 3$	$y = x + 1$	$y = 2x$	$y = 8 - x$																																								
Table	<table> <tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td></tr> <tr><td>y</td><td>3</td><td>4</td><td>5</td><td></td></tr> </table>	x	0	1	2	3	y	3	4	5		<table> <tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td></tr> <tr><td>y</td><td>1</td><td></td><td></td><td>4</td></tr> </table>	x	0	1	2	3	y	1			4	<table> <tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td></tr> <tr><td>y</td><td></td><td></td><td>4</td><td>6</td></tr> </table>	x	0	1	2	3	y			4	6	<table> <tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td></tr> <tr><td>y</td><td></td><td></td><td></td><td>5</td></tr> </table>	x	0	1	2	3	y				5
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y			4	6																																								
x	0	1	2	3																																								
y				5																																								
Graph																																												

Equation	$y = 2x + 1$	$y = x - 1$	$y = 2 - x$	$y = 0.5x + 3$																																								
Table	<table> <tr><td>x</td><td>-2</td><td>-1</td><td>0</td><td>1</td></tr> <tr><td>y</td><td>-3</td><td>-1</td><td></td><td></td></tr> </table>	x	-2	-1	0	1	y	-3	-1			<table> <tr><td>x</td><td>-2</td><td>-1</td><td>0</td><td>1</td></tr> <tr><td>y</td><td></td><td></td><td>-1</td><td></td></tr> </table>	x	-2	-1	0	1	y			-1		<table> <tr><td>x</td><td>-2</td><td>-1</td><td>0</td><td>1</td></tr> <tr><td>y</td><td></td><td></td><td>2</td><td></td></tr> </table>	x	-2	-1	0	1	y			2		<table> <tr><td>x</td><td>-2</td><td>-1</td><td>0</td><td>1</td></tr> <tr><td>y</td><td></td><td></td><td></td><td>3.5</td></tr> </table>	x	-2	-1	0	1	y				3.5
x	-2	-1	0	1																																								
y	-3	-1																																										
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y			2																																									
x	-2	-1	0	1																																								
y				3.5																																								
Graph																																												

Worked Example

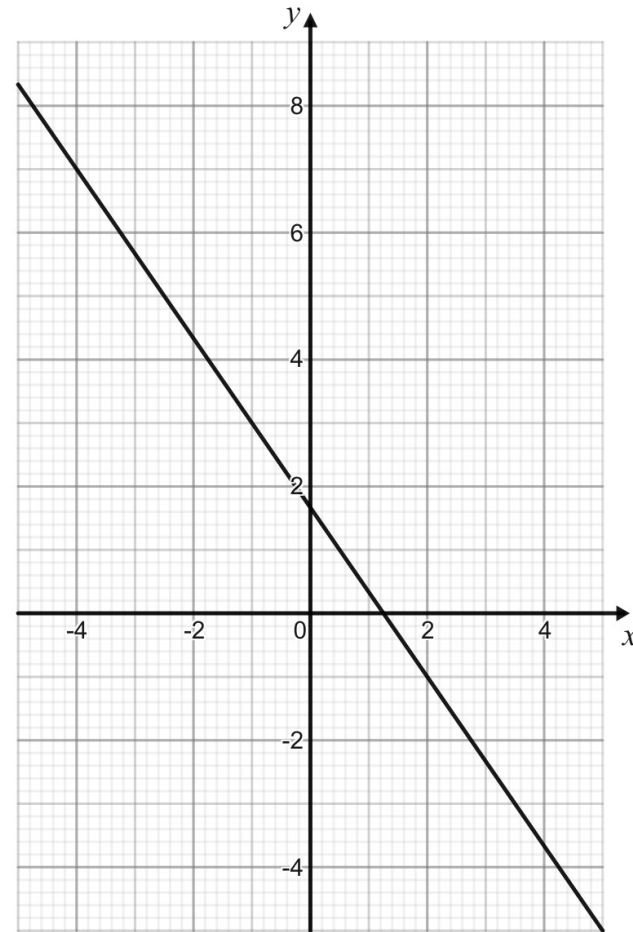
The line passes through the point $(6, c)$



Find the value of c

Your Turn

The line passes through the point $(-4, a)$

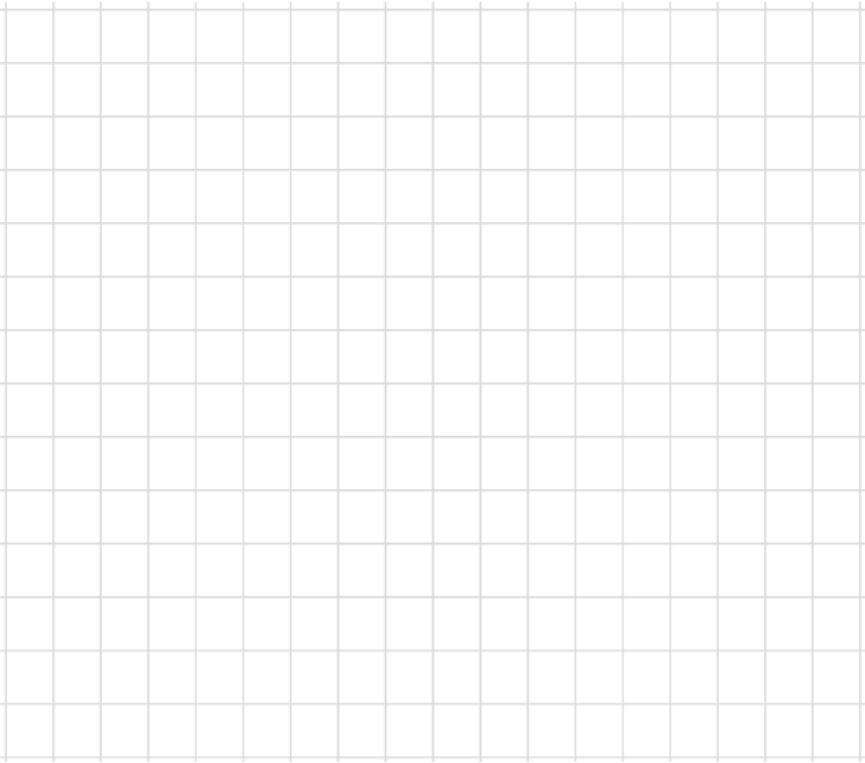


Find the value of a

Worked Example

Plot the graph of $2x + y = 8$ for the values $-2 \leq x \leq 2$

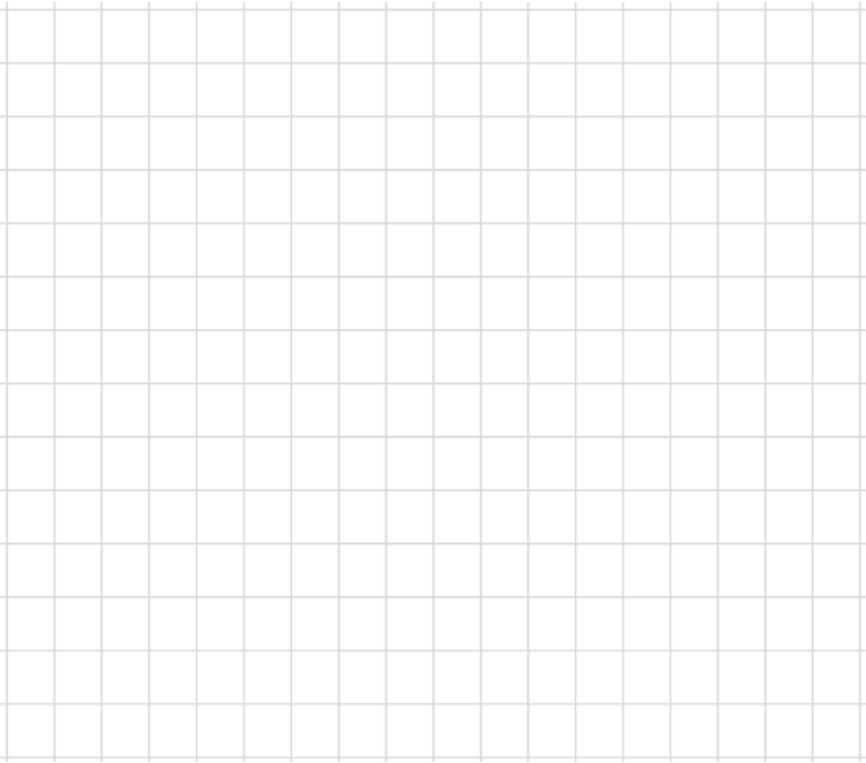
x					
y					
Coordinates					



Your Turn

Plot the graph of $2x - y = 8$ for the values $-2 \leq x \leq 2$

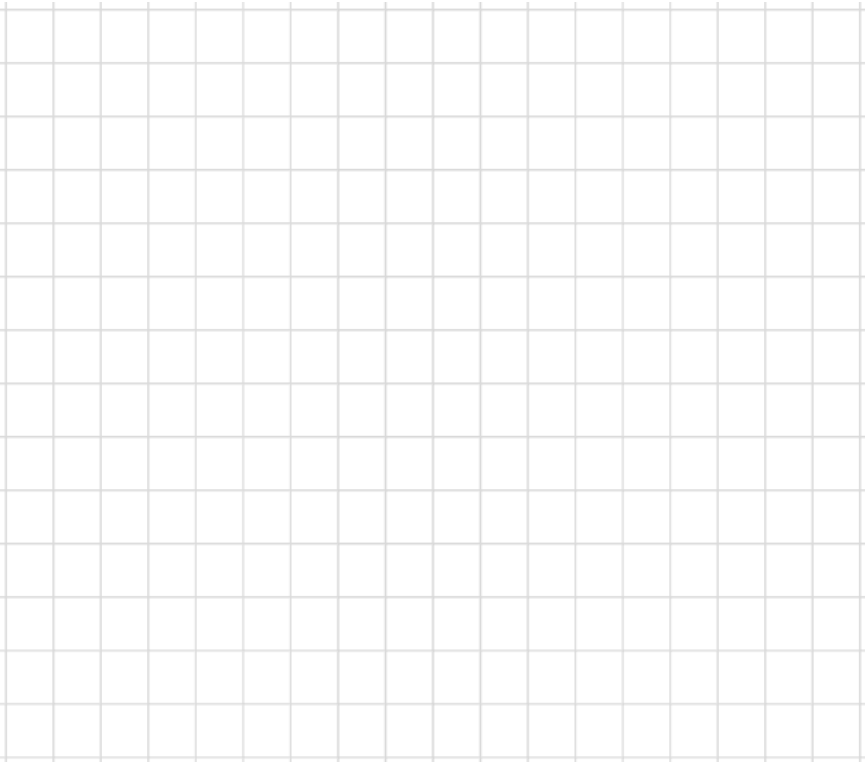
x					
y					
Coordinates					



Worked Example

Plot the graph of $x + 2y = 8$ for the values $-2 \leq x \leq 2$

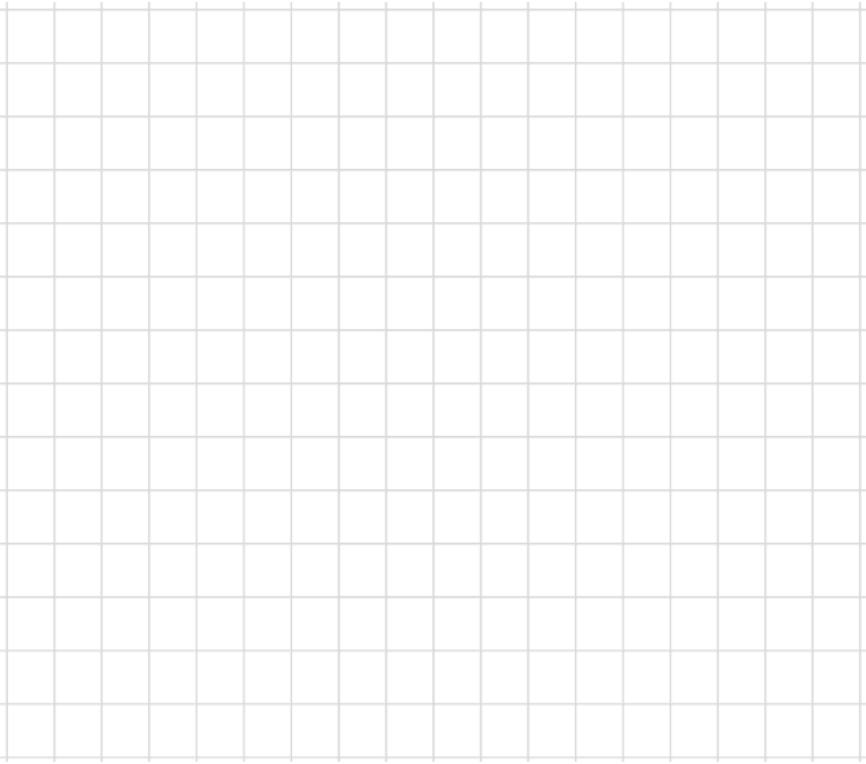
x					
y					
Coordinates					



Your Turn

Plot the graph of $x - 2y = 8$ for the values $-2 \leq x \leq 2$

x					
y					
Coordinates					



Worked Example

Plot the graph of $2x + 3y = 12$

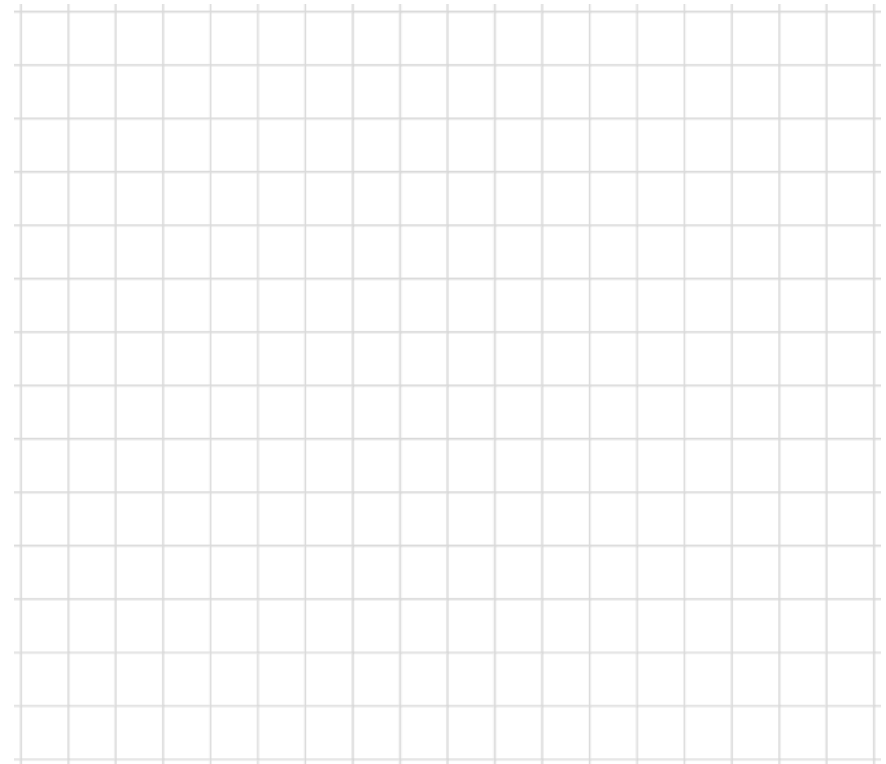
x	0	
y		0
Coordinates		



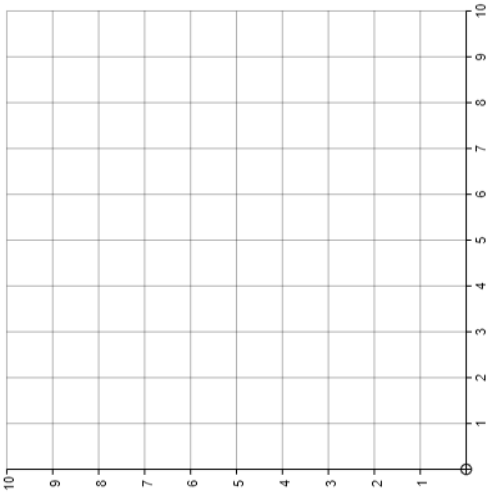
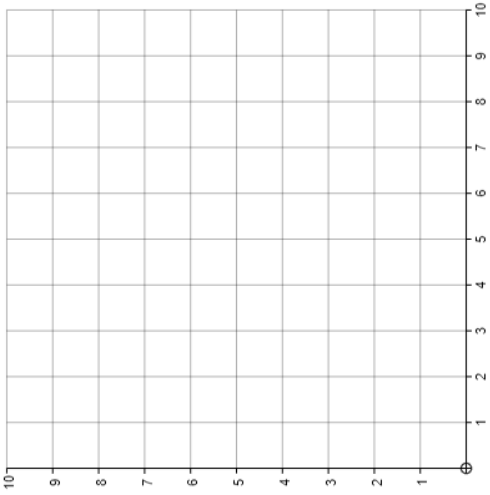
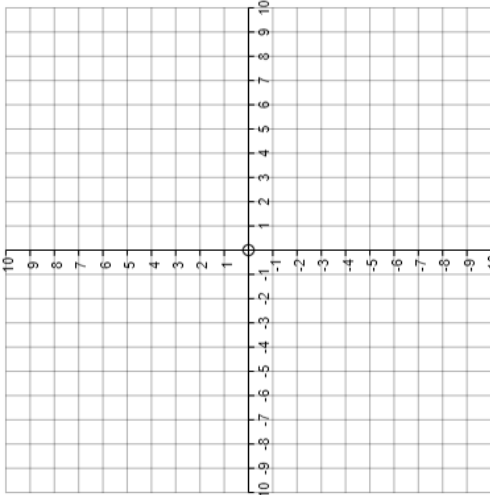
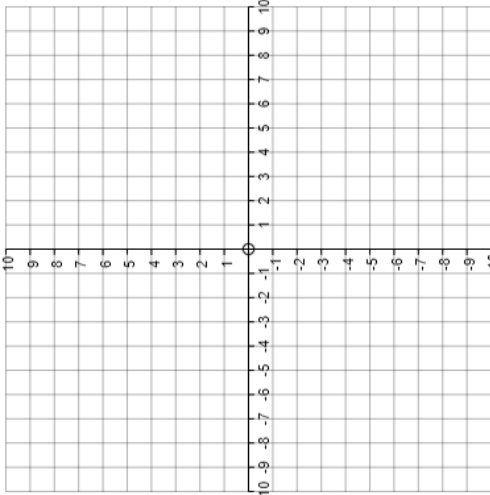
Your Turn

Plot the graph of $4x - 3y = 24$

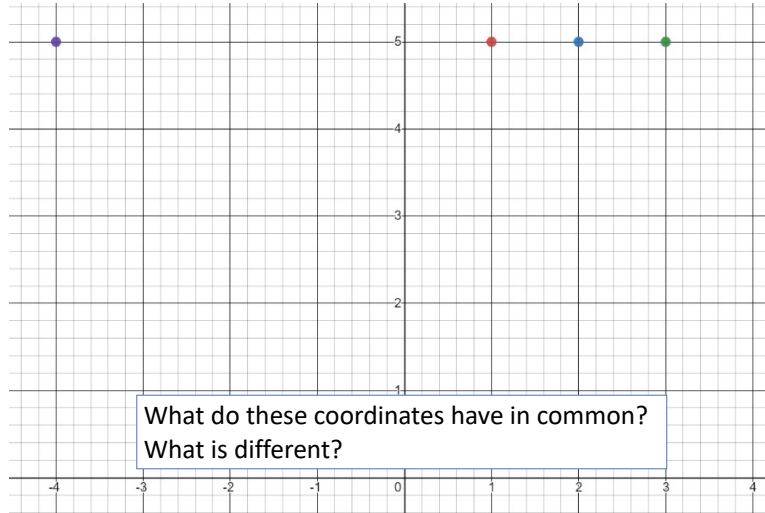
x	0	
y		0
Coordinates		



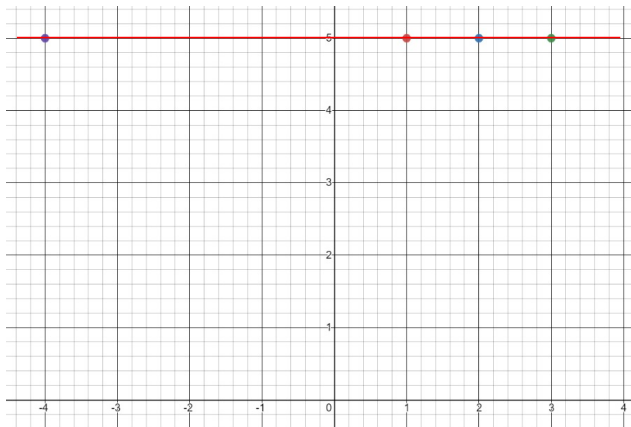
Fluency Practice

Plotting Linear Graphs Using the Cover-Up Method			
(a) $2x + y = 6$	(b) $x + 3y = 9$		
When $x = 0, y =$	When $x = 0, y =$		
When $y = 0, x =$	When $y = 0, x =$		
			
(c) $5x + 2y = 10$	(d) $3x + 2y = 9$		
When $x = 0, y =$	When $x = 0, y =$		
When $y = 0, x =$	When $y = 0, x =$		
			

Horizontal and Vertical Lines

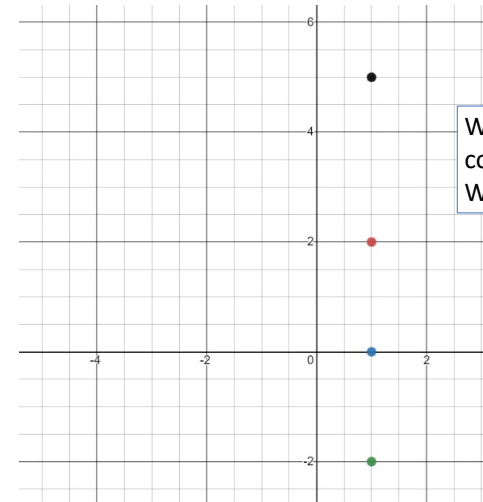


The relationship of the shared characteristic between points can be written as an equation.

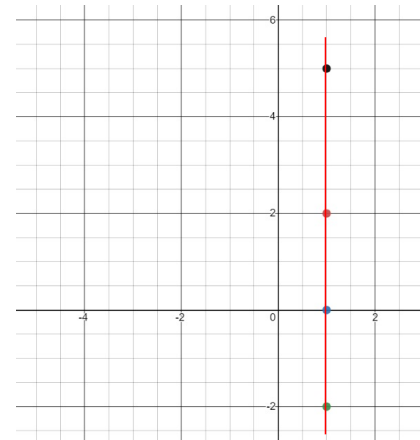


All of these points have a y coordinate of 5.

The straight line can be described as $y = 5$ because this is true for every point on the line.



The relationship of the shared characteristic between points can be written as an equation.

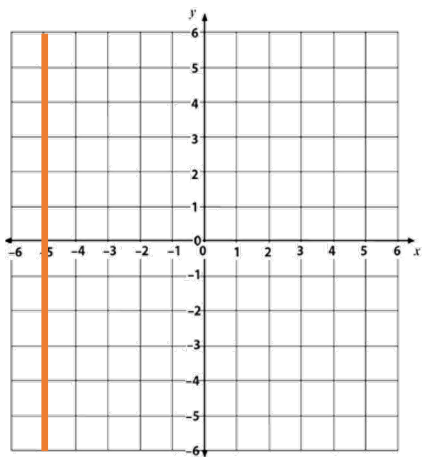
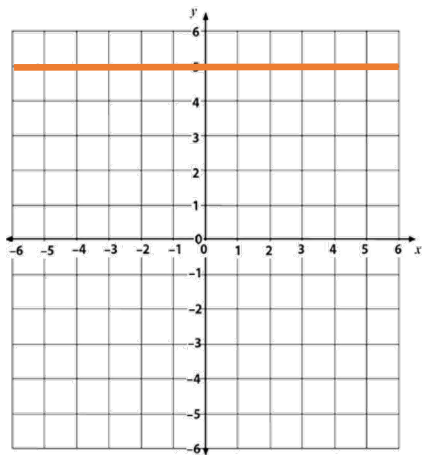


All of these points have an x coordinate of 1.

The straight line can be described as $x = 1$ because this is true for every point on the line.

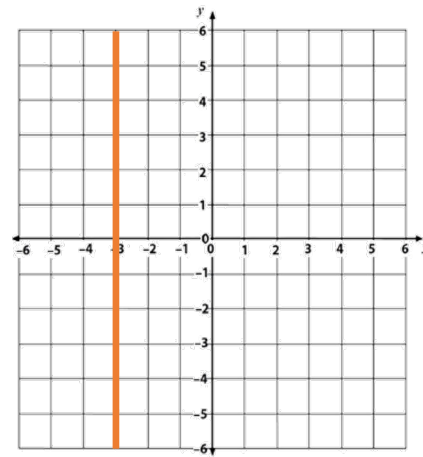
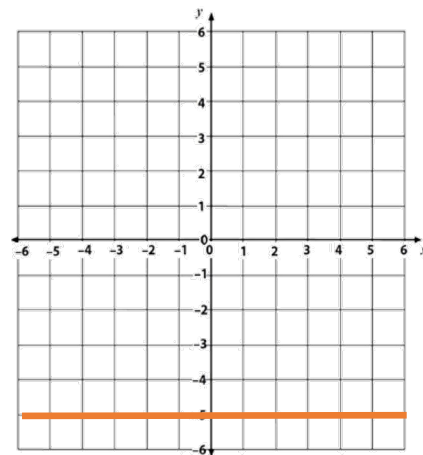
Worked Example

Find the equation of the line:



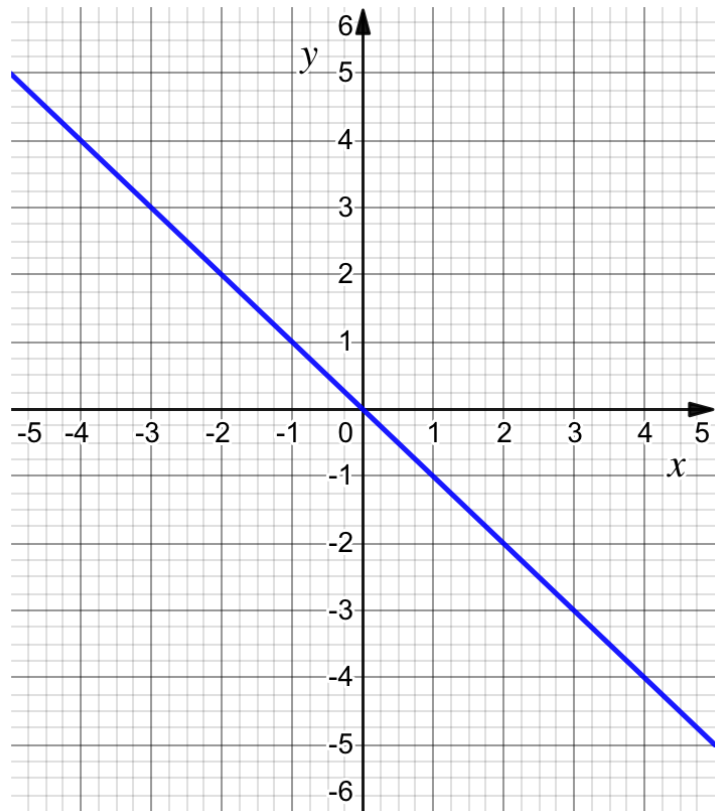
Your Turn

Find the equation of the line:



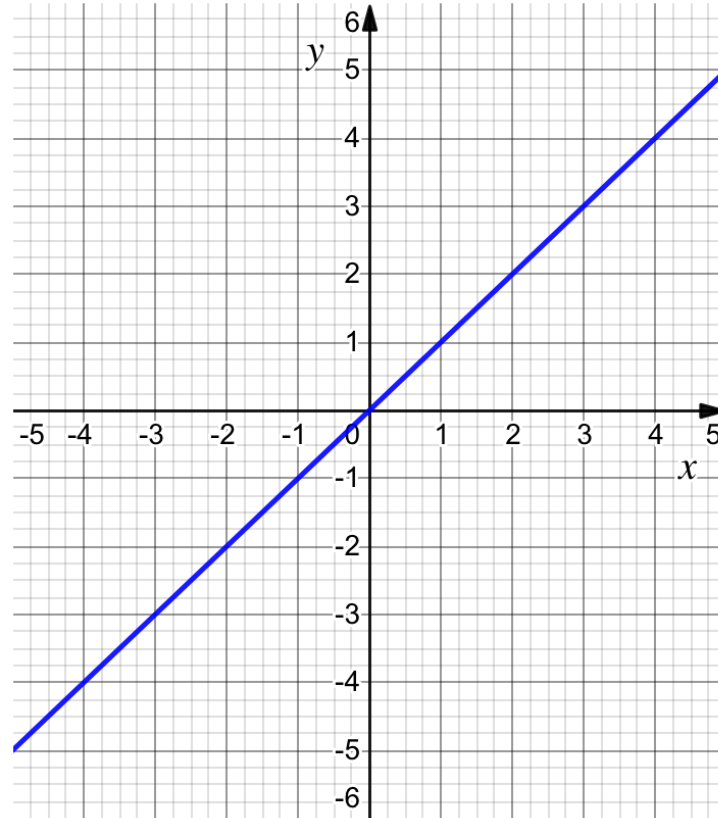
Worked Example

Find the equation of the line:

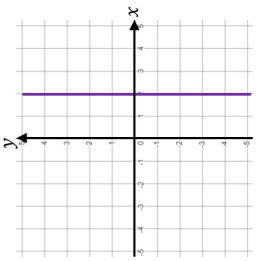


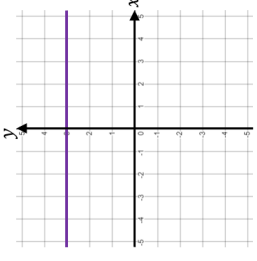
Your Turn

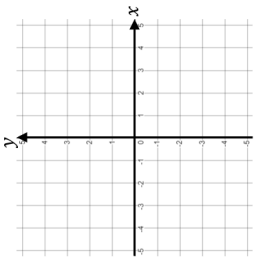
Find the equation of the line:

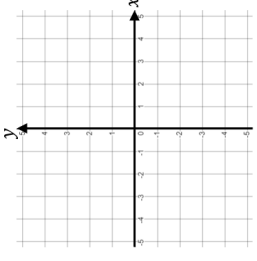


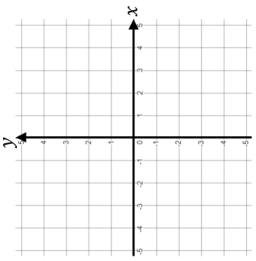
Fill in the Gaps

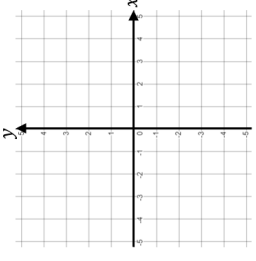
Graph	Points on Line
	(2, 1)
	(2, 0)
	(2, -4)
Equation	

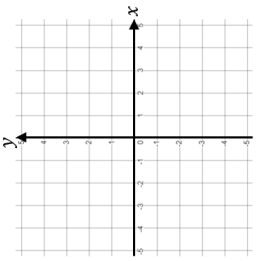
Graph	Points on Line
	(1, 3)
Equation	

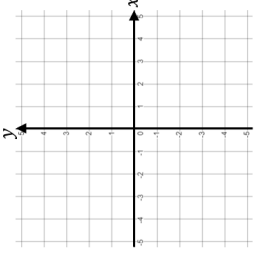
Graph	Points on Line
	(3, 1)
	(-1, 1)
Equation	$y = 1$

Graph	Points on Line
	(-2, 4)
Equation	$x = -2$

Graph	Points on Line
	(0, 3)
	(0, -1)
Equation	

Graph	Points on Line
	
Equation	$y = -2.5$

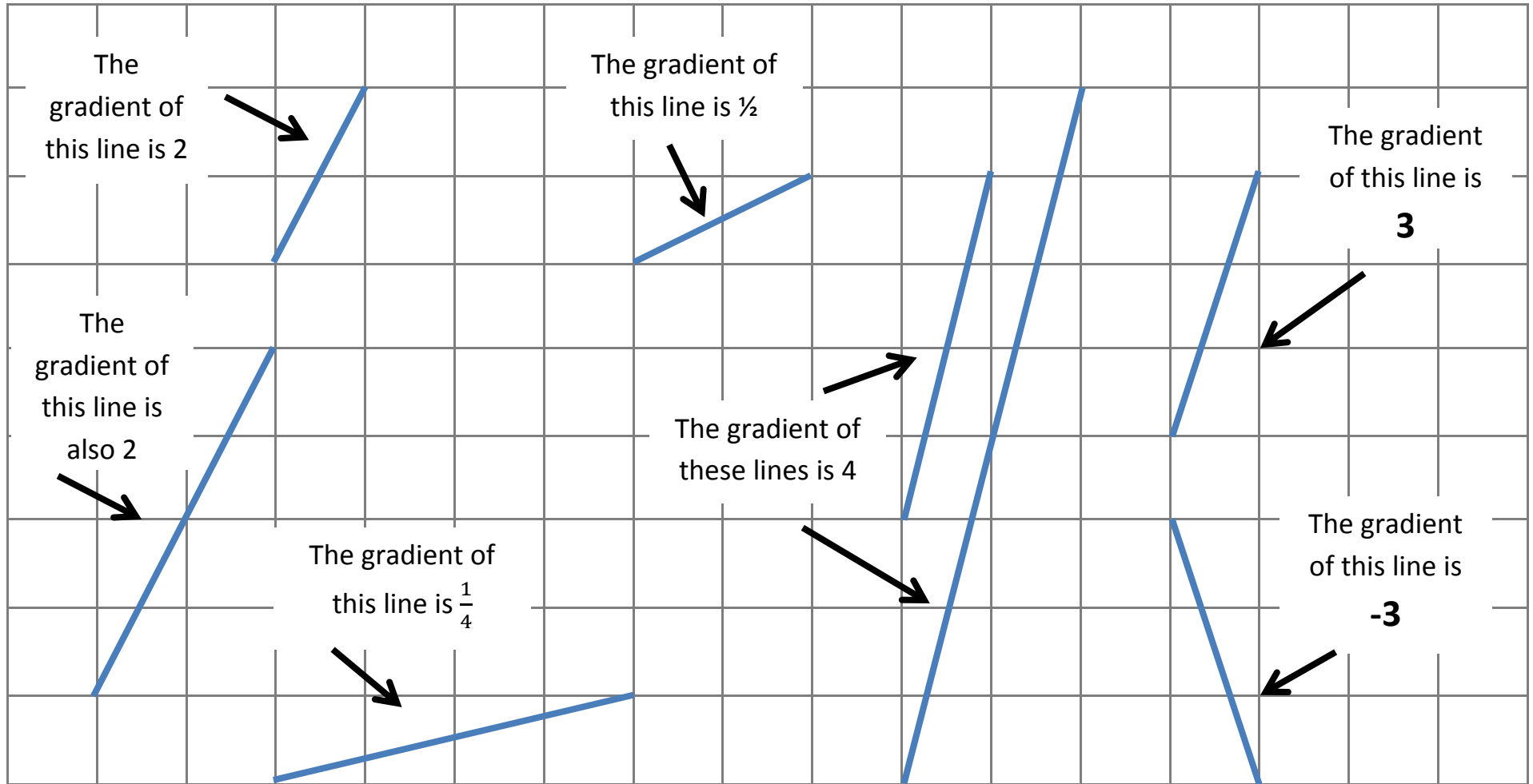
Graph	Points on Line
	(2, 2)
	(5, 5)
	(-1, -1)
Equation	

Graph	Points on Line
	
Equation	$y = -x$

Gradient

Fluency Practice

Look at these pictures and try to figure out what the word 'gradient' means:



Worked Example

Calculate the gradient between the coordinates:

- a) $(-2, -1)$ and $(5, 7)$
- b) $(2, -1)$ and $(-5, -7)$

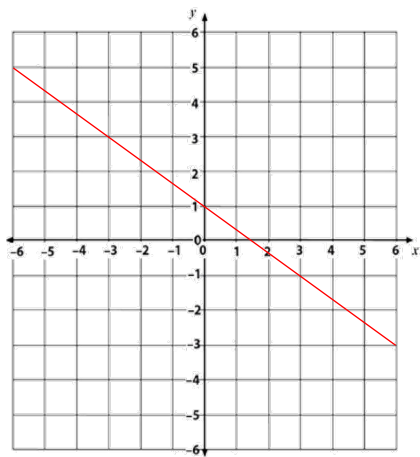
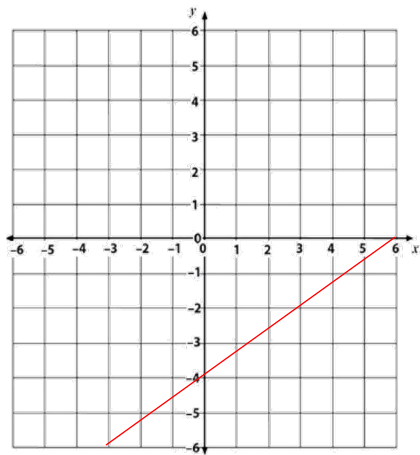
Your Turn

Calculate the gradient between the coordinates:

- a) $(-4, 2)$ and $(6, 8)$
- b) $(-4, 2)$ and $(-6, -8)$

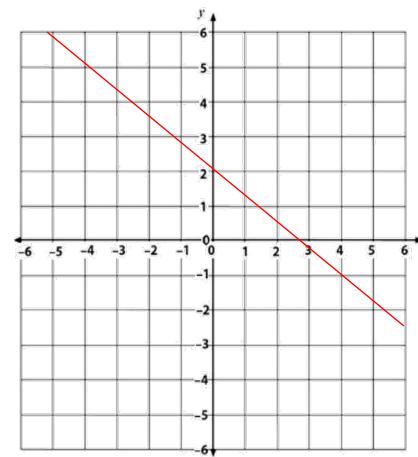
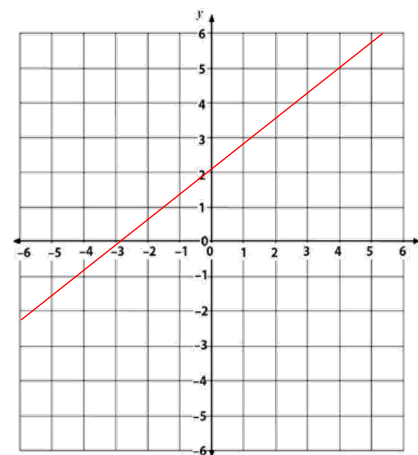
Worked Example

Find the gradient of:



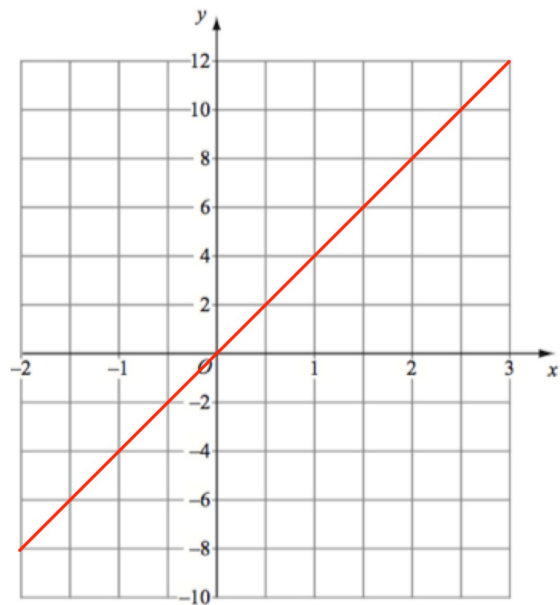
Your Turn

Find the gradient of:



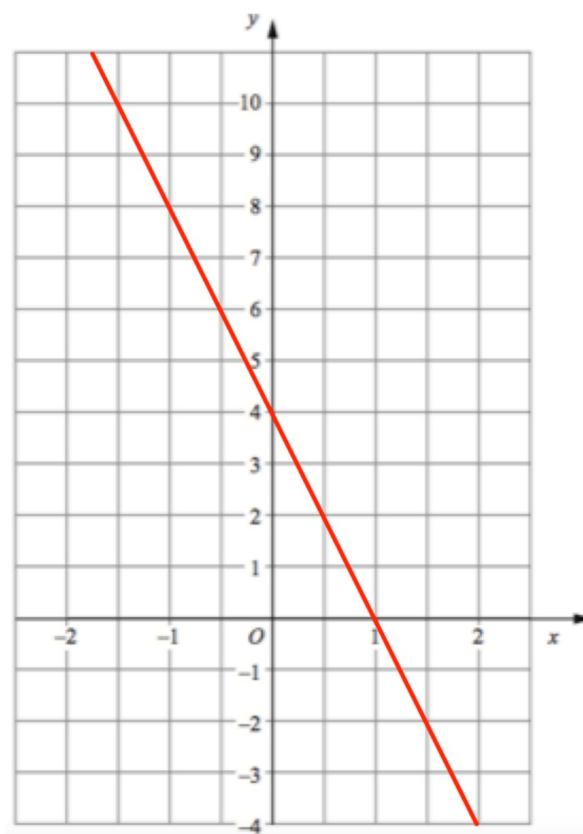
Worked Example

Find the gradient of:



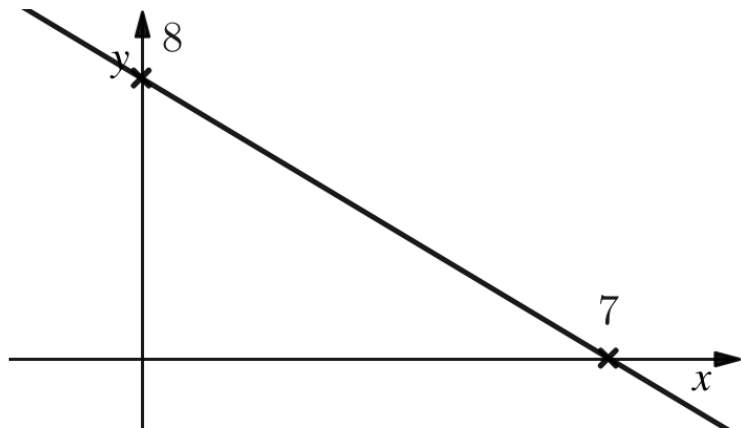
Your Turn

Find the gradient of:



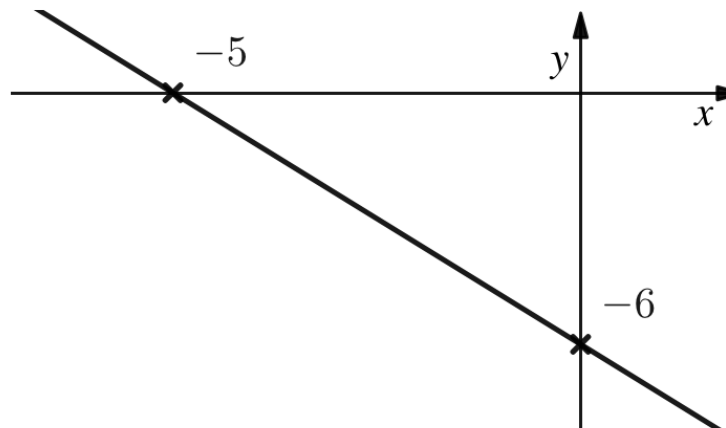
Worked Example

Find the gradient of:



Your Turn

Find the gradient of:



Worked Example

The gradient connecting the two points $(2a, 5)$ and $(7a, 8)$ is 6. Solve for a .

Your Turn

The gradient connecting the two points $(3a, 7)$ and $(5a, 12)$ is 6. Solve for a .

Worked Example

The gradient connecting the two points $(2, 10)$ and $(5, d)$ is 4. Solve for d .

Your Turn

The gradient connecting the two points $(-3, -10)$ and $(2, d)$ is 12. Solve for d .

Worked Example

The line L passes through the points $(-2, -6)$ and $(10, s)$.
Given that the gradient of the line is $\frac{2}{3}$, find the value of s .

Your Turn

The line L passes through the points $(-3, -8)$ and $(-8, p)$.
Given that the gradient of the line is $\frac{8}{5}$, find the value of p .

Collinear Lines

Worked Example	Your Turn
The coordinates $(5, -2)$, $(8, -1)$ and $(17, r)$ are collinear. Determine the value of r.	The coordinates $(-2, -1)$, $(18, 27)$ and $(33, s)$ are collinear. Determine the value of s.

Worked Example	Your Turn
Determine whether the points $A(2, -4)$, $B(12, 1)$ and $C(20, 5)$ are collinear.	Determine whether the points $A(5, -5)$, $B(17, 27)$ and $C(32, 62)$ are collinear.

Worked Example	Your Turn
$y = 2x - 1$ Gradient: y-intercept:	$y = 3x - 4$ Gradient: y-intercept:
$y = -2x + 6$ Gradient: y-intercept:	$y = -3x - 6$ Gradient: y-intercept:
$2x - 3y = 6$ Gradient: y-intercept:	$3x + 2y = 6$ Gradient: y-intercept:

Worked Example

Determine the steepest line.

$$5x - 2y = 8$$

$$x + 4y = 10$$

$$6x + 10y = -35$$

$$y = -\frac{4}{5}x + 15$$

Your Turn

Determine the steepest line.

$$3x - 2y - 6 = 0$$

$$7x - 2y + 8 = 0$$

$$8x - 20y = -15$$

$$y = \frac{4}{5}x - 25$$

Worked Example

Write in the form $y = mx + c$ the line with:

Gradient 2 and y -intercept 3

Gradient $\frac{2}{3}$ and y -intercept -3

Gradient $-\frac{3}{2}$ and y -intercept 0

Gradient 0 and y -intercept 4

Your Turn

Write in the form $y = mx + c$ the line with:

Gradient 3 and y -intercept 4

Gradient $-\frac{5}{6}$ and y -intercept -1

Gradient $\frac{3}{4}$ and y -intercept 0

Gradient 0 and y -intercept -5

Worked Example

Write in the form $ax + by = c$ (where a , b and c are integers in their lowest terms) the line with:

Gradient 2 and y -intercept 3

Gradient $\frac{2}{3}$ and y -intercept -3

Gradient $-\frac{3}{2}$ and y -intercept 0

Gradient 0 and y -intercept 4

Your Turn

Write in the form $ax + by = c$ (where a , b and c are integers in their lowest terms) the line with:

Gradient 3 and y -intercept 4

Gradient $-\frac{5}{6}$ and y -intercept -1

Gradient $\frac{3}{4}$ and y -intercept 0

Gradient 0 and y -intercept -5

Fill in the Gaps

Equation	Gradient	y-intercept
$y = 2x + 3$	2	(0, 3)
$y = 4x + 3$	4	
$y = 4x - 3$		(0, -3)
$y = 2x - 1$		
$y = 3x + 5$		
$y = x + 2$		
$y = 7x$		
$y = \frac{1}{2}x - 3$		
$y = \frac{2}{3}x + \frac{4}{3}$		
$y = -3x + 6$	-3	
$y = -2x - 1$		
$y = -5x + 2$		
$y = -x$		
$y = -\frac{1}{2}x + 4$		

Equation	Gradient	y-intercept
$y = -\frac{3}{2}x + 1$		
$y = -\frac{2}{5}x - \frac{4}{5}$		
	3	(0, 6)
	4	(0, 1)
	-2	(0, 0)
	1	(0, -3)
	$1\frac{1}{3}$	(0, -5)
	$4\frac{4}{5}$	$(0, \frac{2}{5})$
	-1	(0, 8)
$2y = 6x - 10$		
$y + 2x = 7$		
$6x + 3y = 18$		
$x - 2y = 8$		
$3y = 5x - 6$		

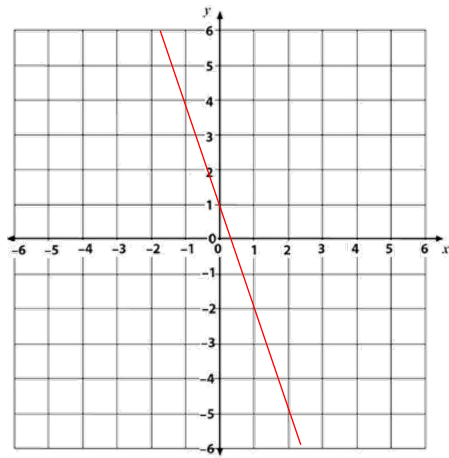
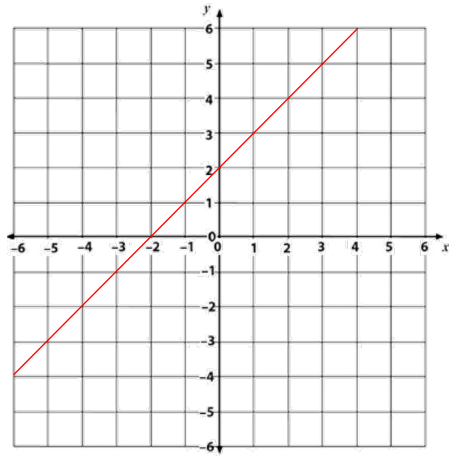
Fill in the Gaps

Equation of Line	Equation in $y = mx + c$ form	Gradient	y-intercept
$4x + y = 11$	$y = -4x + 11$	-4	(0, 11)
$y - 3x = 8$			
$0 = 5x + y + 7$			
$3 = 2x - y$			
$6 - 5x - y = 0$			
$2y = 7x$			
$9x + 15 = 3y$			
$5y - 10 = 30x$			
$4x + 3y = 11$			
$14 = 5y - 2x$			
$6x - 2y = 16$			
$30 = 8x - 5y$			
$x + \boxed{}y = \boxed{}$		$-\frac{1}{2}$	(0, 3)
$\boxed{}x - \boxed{}y = \boxed{}$		$\frac{4}{3}$	$(0, -\frac{7}{3})$

Equation of Straight Line Graphs

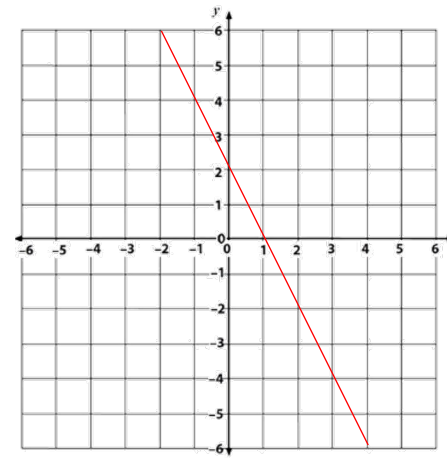
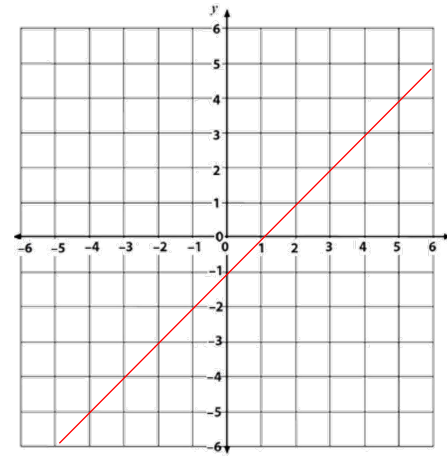
Worked Example

Find the equation of:



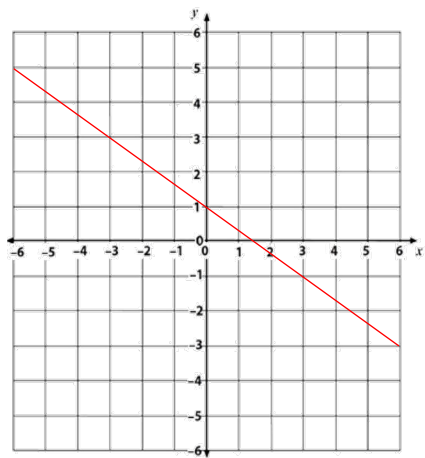
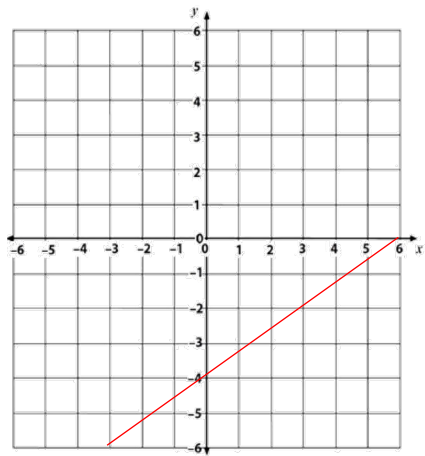
Your Turn

Find the equation of:



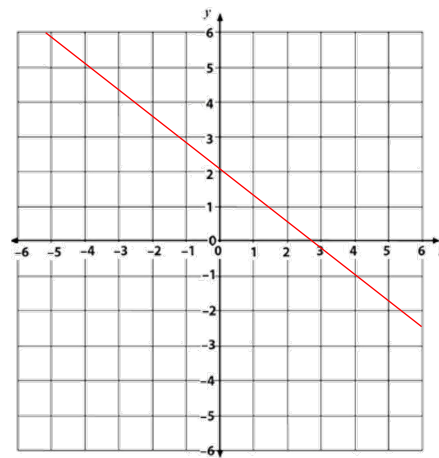
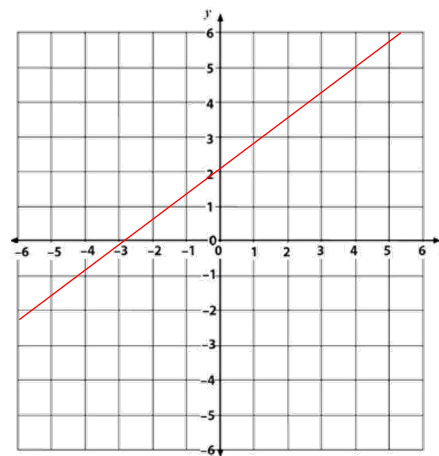
Worked Example

Find the equation of:



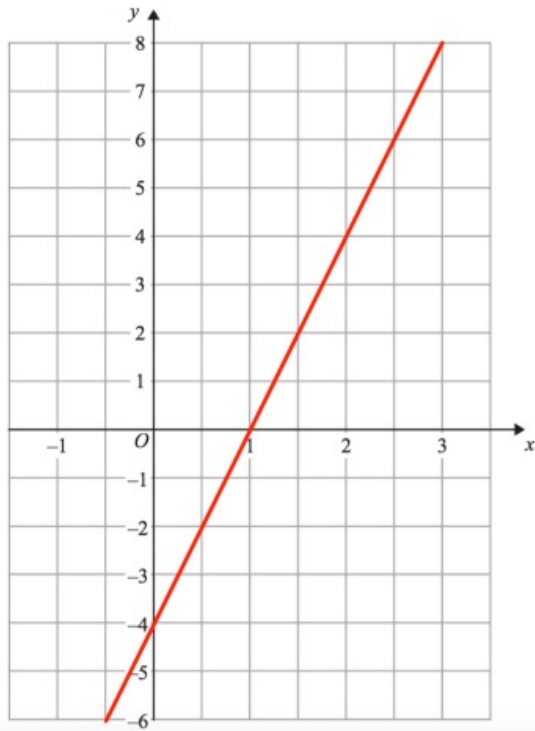
Your Turn

Find the equation of:



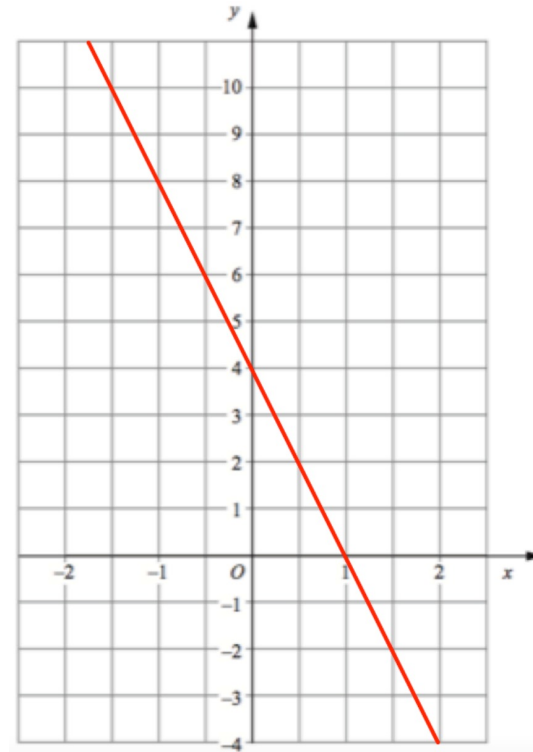
Worked Example

Find the equation of:



Your Turn

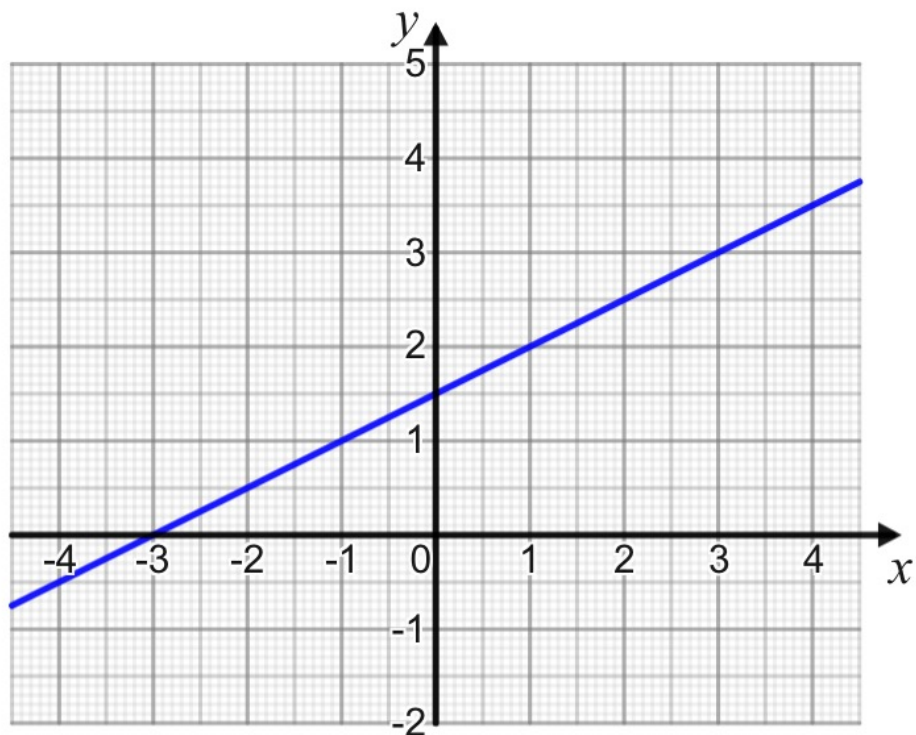
Find the equation of:



Worked Example

Write down the equation of the line drawn below.

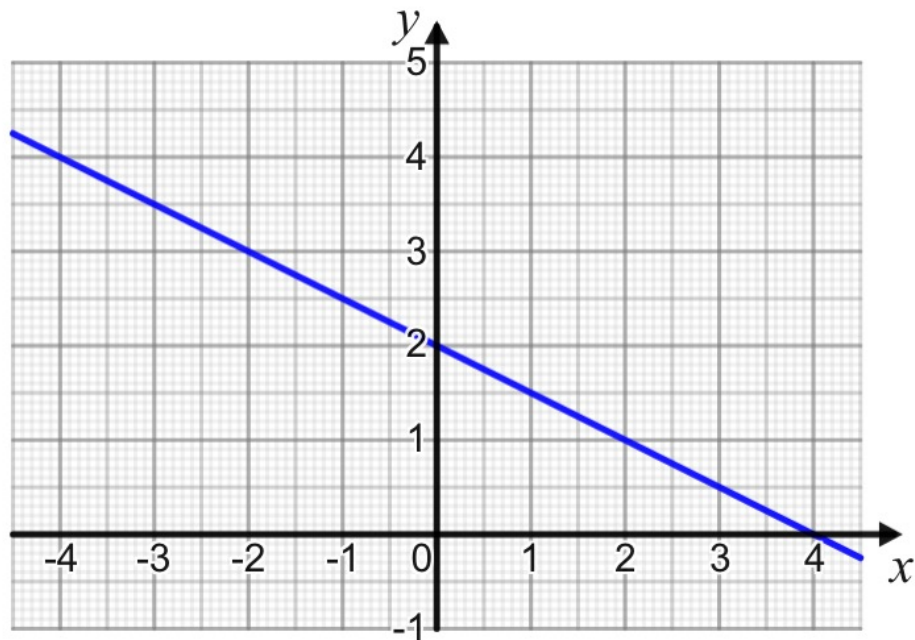
Give your answer in the form $ax + by = c$
where a , b and c are integers in their lowest terms.



Your Turn

Write down the equation of the line drawn below.

Give your answer in the form $ax + by = c$
where a , b and c are integers in their lowest terms.



Worked Example

Find the equation of the line, given a point and the gradient:
 $(-6, 22)$ Gradient 3

Your Turn

Find the equation of the line, given a point and the gradient:
 $(-2, 5)$ Gradient 4

Worked Example

Write the equation of the line with gradient $-\frac{2}{3}$ and that passes through the point $(1, 5)$

Give your answer in the form $ax + by = c$
where a , b and c are integers in their lowest terms.

Your Turn

Write the equation of the line with gradient $\frac{4}{5}$ and that passes through the point $(-3, 1)$

Give your answer in the form $ax + by = c$
where a , b and c are integers in their lowest terms.

Worked Example

Write the equation of the line in the form $y = mx + c$ which passes through the points $(2, 3)$ and $(5, -9)$

Your Turn

Write the equation of the line in the form $y = mx + c$ which passes through the points $(3, 10)$ and $(-5, 18)$

Fill in the Gaps

(x_1, y_1)	(x_2, y_2)	Find m using $\frac{y_2 - y_1}{x_2 - x_1}$	Gradient m	Find c using $y = mx + c$	Equation of Line
(1, 3)	(2, 5)	$\frac{5 - 3}{2 - 1} = \frac{2}{1}$	2	$3 = 2 \times 1 + c$ $c = 1$	$y = 2x + 1$
(2, 0)	(5, 9)				
(4, 1)	(5, 6)				
(7, 11)	(8, 10)				
(2, -3)	(5, 3)				
(3, -2)	(1, 8)				
(-6, -1)	(-2, 1)				
(9, 7)	(3, 9)				
$(\frac{1}{2}, -3)$	$(-\frac{1}{2}, -\frac{5}{2})$				

Worked Example

Write the equation of the line in the form $ax + by = c$ (where a , b and c are integers in their lowest terms) which passes through the points $(2, -3)$ and $(7, -5)$

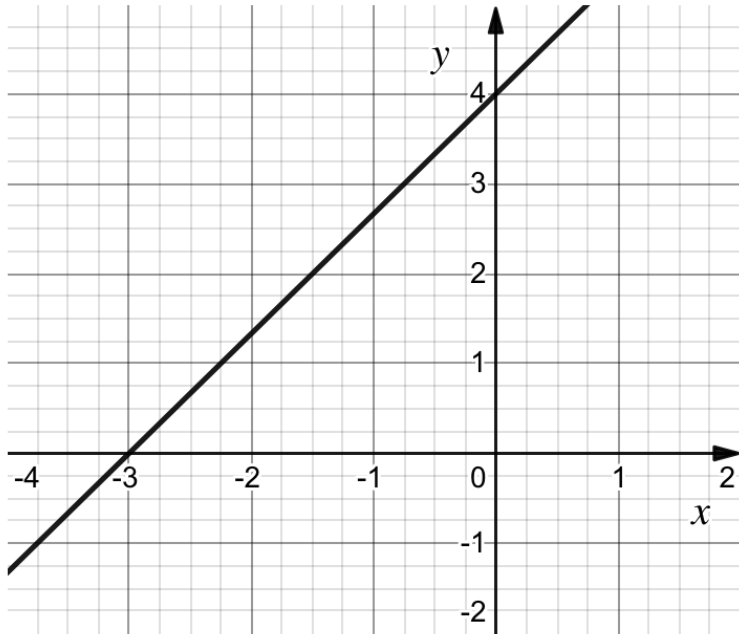
Your Turn

Write the equation of the line in the form $ax + by = c$ (where a , b and c are integers in their lowest terms) which passes through the points $(3, -2)$ and $(-7, 5)$

x -intercept and y -intercept

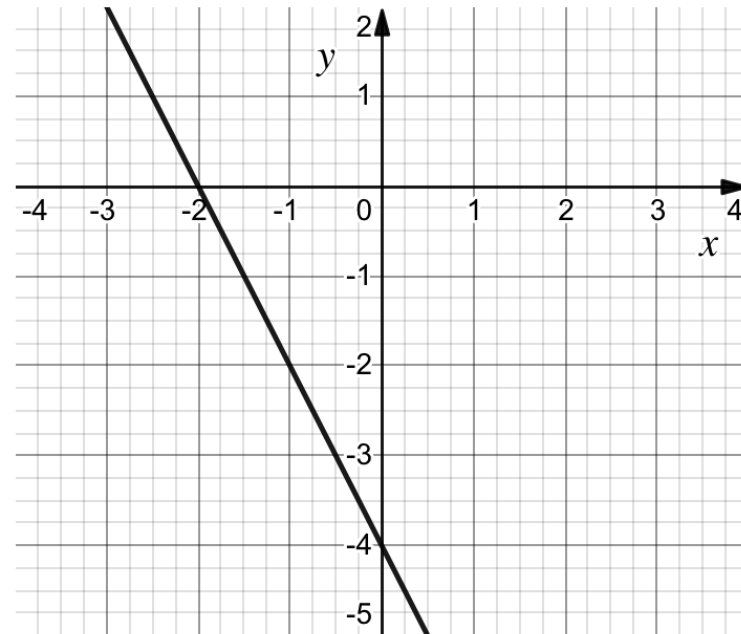
Worked Example

Find where the line intercepts the axes:



Your Turn

Find where the line intercepts the axes:



Worked Example

Find where the line intercepts the axes:

Line	x -intercept	y -intercept
$y = 3x - 2$		
$3x + 2y = 6$		

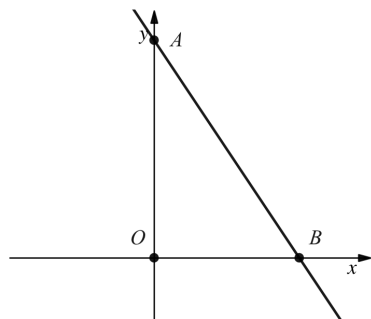
Your Turn

Find where the line intercepts the axes:

Line	x -intercept	y -intercept
$y = 5 - 4x$		
$5x - 4y = 20$		

Worked Example

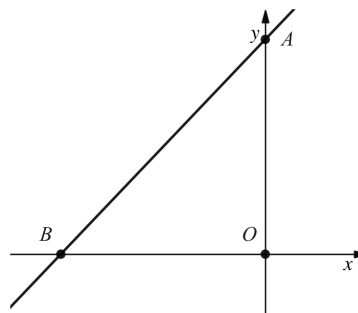
A sketch of the line with equation $7x + 2y = 14$ is shown below. The line passes through the points A and B .



Calculate the area of the triangle OAB .

Your Turn

A sketch of the line with equation $7x - 4y = -28$ is shown below. The line passes through the points A and B .



Calculate the area of the triangle OAB .

Does a Point lie on a Straight Line?

Worked Example

Does the point $(2, 9)$ lie on the line $y = 4x + 1$?

Your Turn

Does the point $(-1, 10)$ lie on the line $y = 9 - 2x$?

Worked Example

Determine whether the point with coordinates $(5, 8)$ lies on, above or below the line with equation $5y - 4x = -5$

Your Turn

Determine whether the point with coordinates $(2, -1)$ lies on, above or below the line with equation $3y - 5x = -7$

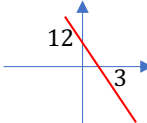
Worked Example

The point $(t, -3)$ lies on the line $-5y + x = 14$.
Calculate the value of t .

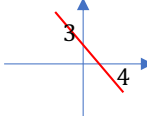
Your Turn

The point $(r, -4)$ lies on the line $-2y + x = 7$.
Calculate the value of r .

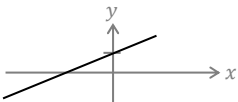
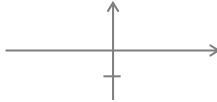
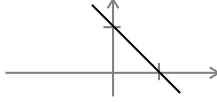
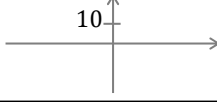
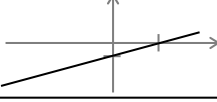
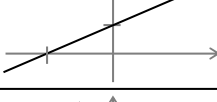
Fill in the Gaps

	$y = mx + c$	$ax + by = d$	Gradient	x intercept	y intercept	Sketch
1.	$y = 2x + 8$					
2.		$2x - y = -6$				
3.			3	$(-3, 0)$		
4.				$(3, 0)$	$(0, -9)$	
5.			4		$(0, -12)$	
6.						
7.				$(12, 0)$	$(0, 3)$	

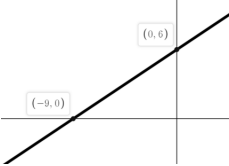
Fill in the Gaps

	$y = mx + c$	$ax + by = d$	Gradient	x intercept	y intercept	Sketch
8.	$y = -\frac{1}{3}x + 4$					
9.		$4x + 3y = 12$				
10.						
11.			$\frac{3}{4}$	$(4, 0)$		
12.		$3x - 4y = 24$				
13.			$1\frac{3}{4}$	$(8, 0)$		
14.				No intercept	$(0, -14)$	

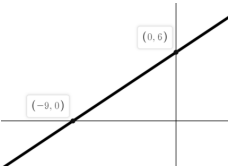
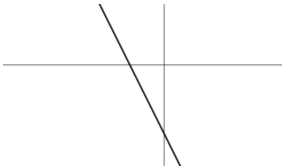
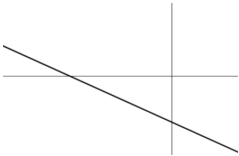
Fill in the Gaps

Linear Graphs				Plotting, Reading, Calculating						Complete the missing information.	
	Equation	Gradient	y-Intercept	Table of Values						Sketch (label marked intercepts)	Coordinates on the Line
A	$y = 2x + 6$			x	-2	-1	0	1	2		(3,)
				y	2			8			(5,)
B			-2	x	-2	-1	0	1	2		(6,)
				y	-10	-6		2	6		(-3,)
C	$y = 4 - x$			x	-2	-1	0	1	2		(3,)
				y							(-4,)
D				x	-2	-1	0	1	2		(4,)
				y	16	13					(-5,)
E	$y = \frac{x}{2} - 8$			x	-4	-2	0	2	4		(-6,)
				y							(3,)
F	$2x + y = 10$			x				0			(4,)
				y		0					(, 20)
G				x		-2		0		3	
				y				-2		16	
H				x	-4	-2	0	2	4		(6,)
				y			1	4			(-12,)
I	$2x + 3y = 24$			x				0			(6,)
				y		0					(, -6)

Fill in the Gaps

Equation of line $y = mx + c$	Equation of line $ax + by + c = 0$, $a, b, c \in \mathbb{Z}$	Gradient of line m	y axis intercept	x axis intercept	Area of triangle enclosed by line and the coordinate axes.	Sketch
Eg1: $y = \frac{2}{3}x + 6$	$2x - 3y + 18 = 0$	$m = \frac{2}{3}$	$x = 0, y = 6$ $\rightarrow (0, 6)$	$y = 0, x = -9$ $\rightarrow (-9, 0)$	Area = $\frac{1}{2}bh$ $\rightarrow \frac{1}{2}(6)(9) = 27\text{units}^2$	
1) $y = \frac{1}{2}x - 5$						
2)		$m = 3$	$x = 0, y = 8$ $\rightarrow (0, 8)$			
3)	$3x + 4y = 12$					
4)			$(0, 7)$	$(14, 0)$		
5)		$m = -\frac{1}{3}$		$(-9, 0)$		

Fill in the Gaps

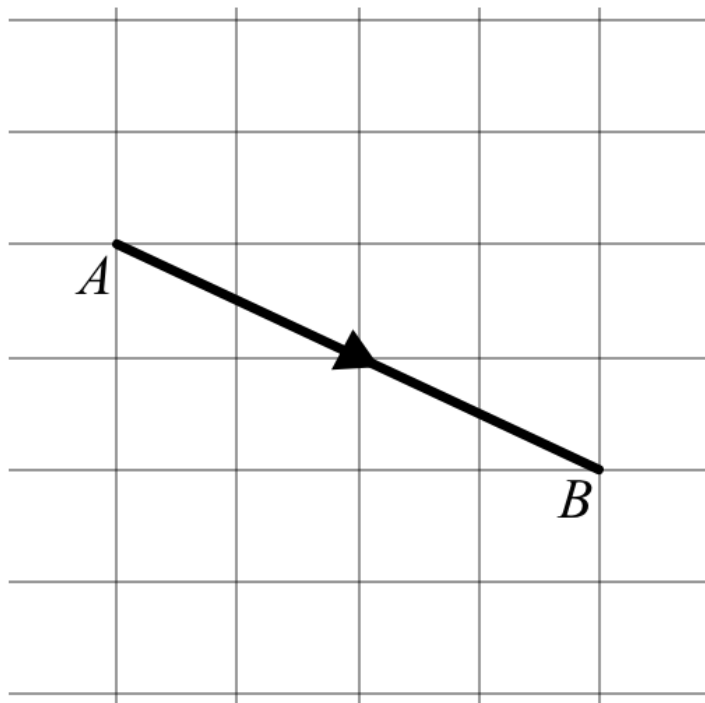
Equation of line $y = mx + c$	Equation of line $ax + by + c = 0$, $a, b, c \in \mathbb{Z}$	Gradient of line m	y axis intercept	x axis intercept	Area of triangle enclosed by line and the coordinate axes.	Sketch
Eg1: $y = \frac{2}{3}x + 6$	$2x - 3y + 18 = 0$	$m = \frac{2}{3}$	$x = 0, y = 6$ $\rightarrow (0, 6)$	$y = 0, x = -9$ $\rightarrow (-9, 0)$	$\text{Area} = \frac{1}{2}bh$ $\rightarrow \frac{1}{2}(6)(9) = 27 \text{units}^2$	
6)		$m > 0$	$(0, -6)$		$\text{Area} = 7.5 \text{units}^2$	
7)		$m = -5$			$\text{Area} = 10 \text{units}^2$	
8)	$x + ky - 6 = 0$ $k \in \mathbb{R}$	$m = -\frac{1}{4}$				
9) $y = \frac{3}{4}x + k$ $k > 0, k \in \mathbb{R}$					$\text{Area} = 6 \text{units}^2$	
10)						

Extra Notes

3 Basic Vectors

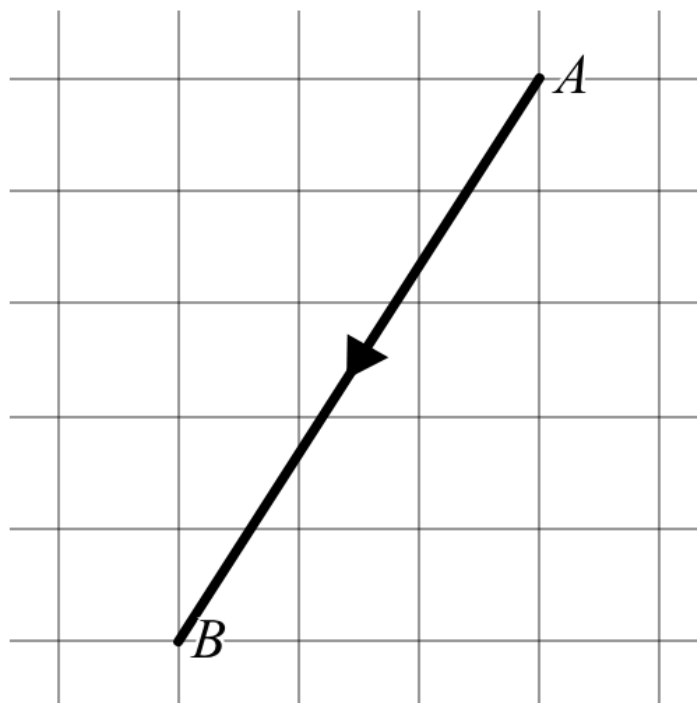
Worked Example

Determine the vector for AB



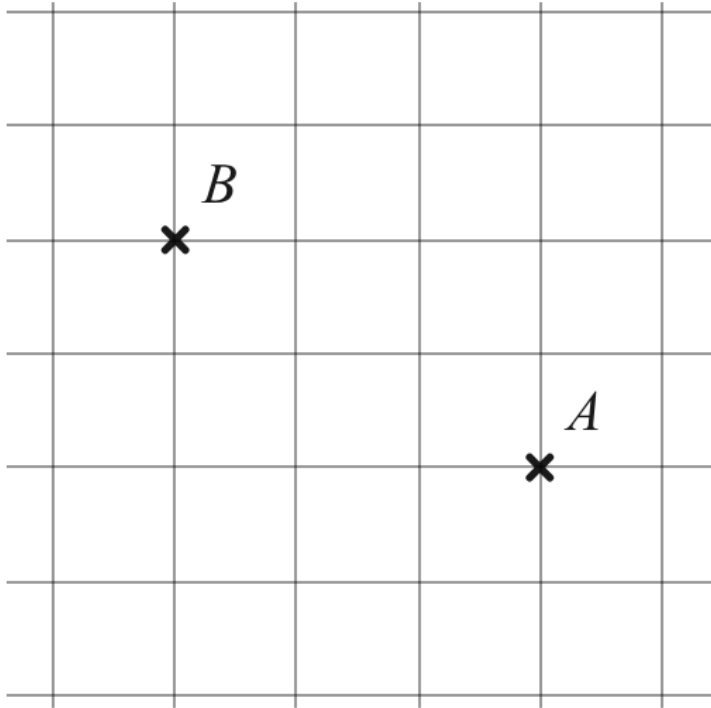
Your Turn

Determine the vector for AB



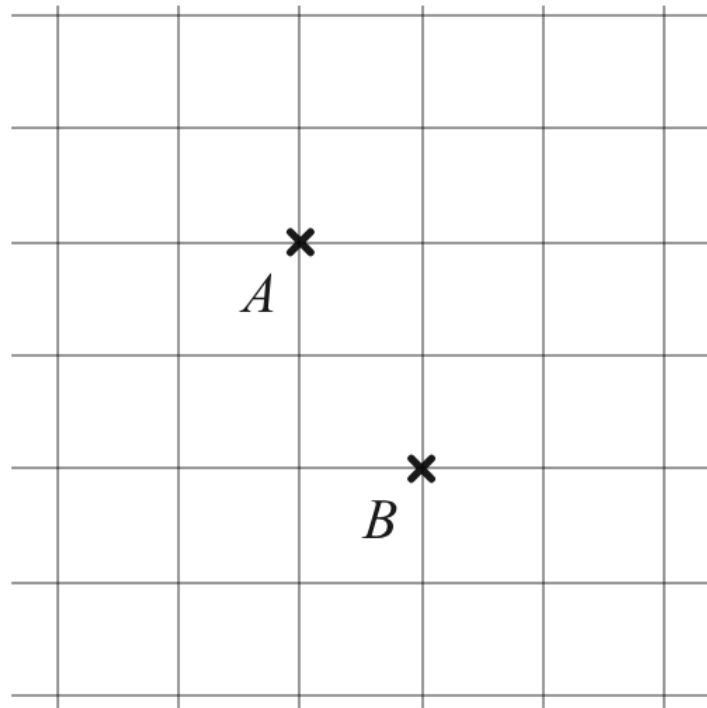
Worked Example

Determine the vector to move from A to B .



Your Turn

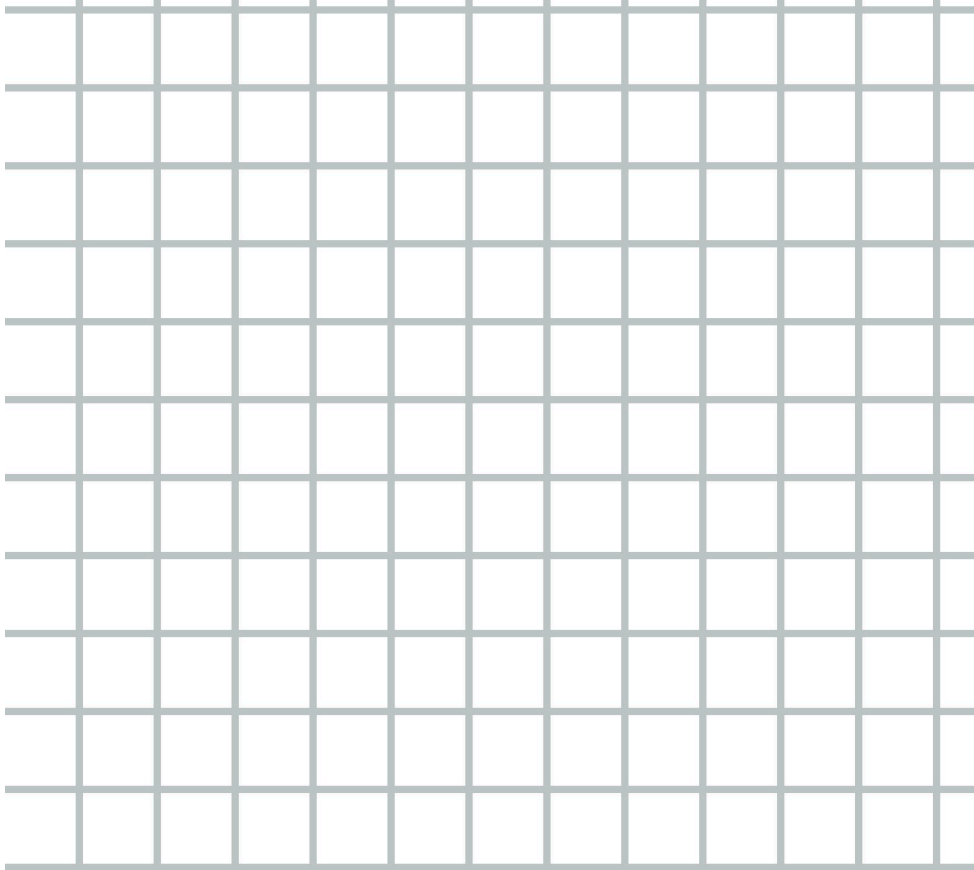
Determine the vector to move from A to B .



Worked Example

$$\mathbf{a} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$$

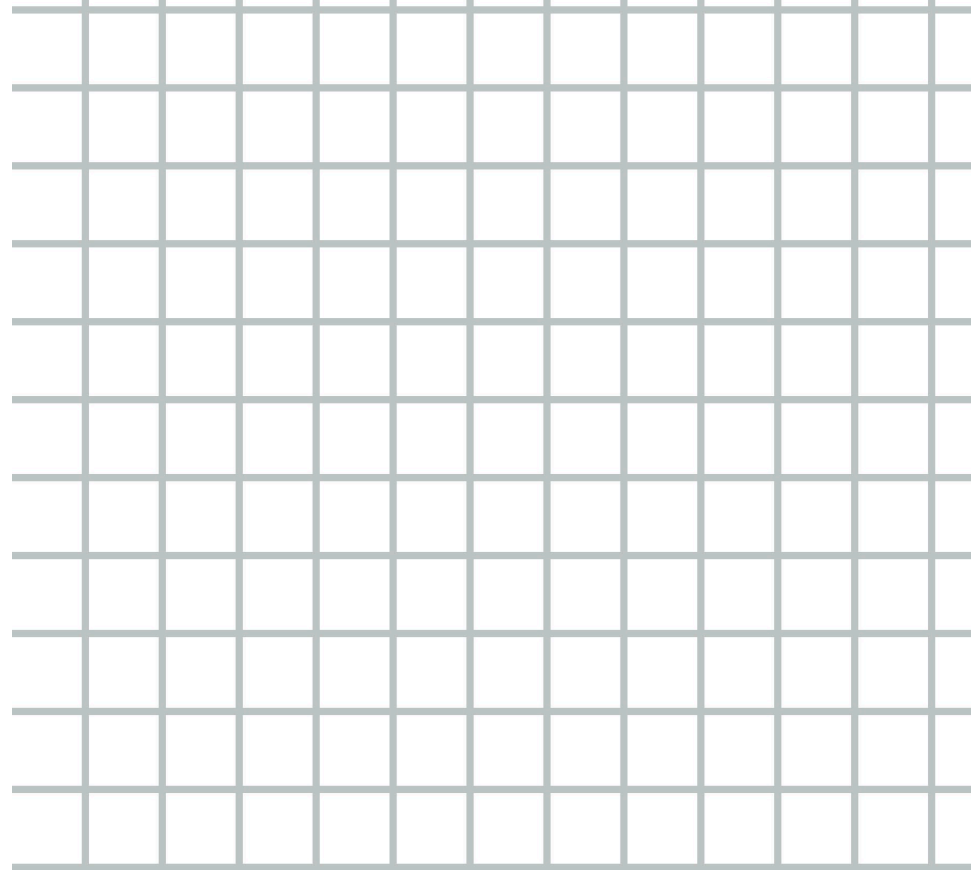
Find $3\mathbf{a}$ and draw it below



Your Turn

$$\mathbf{a} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$$

Find $-2\mathbf{a}$ and draw it below



Worked Example

$$\mathbf{a} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$$

$$\mathbf{b} = \begin{pmatrix} 5 \\ 7 \end{pmatrix}$$

Find $3\mathbf{a} - 2\mathbf{b}$

Your Turn

$$\mathbf{a} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$$

$$\mathbf{b} = \begin{pmatrix} 5 \\ 7 \end{pmatrix}$$

Find $4\mathbf{a} - 3\mathbf{b}$

Worked Example

Given that:

$$3 \binom{x}{7} + 5 \binom{x}{8} = \binom{8}{61}$$

Find the value of x

Your Turn

Given that:

$$4 \binom{3}{x} - 5 \binom{0}{x} = \binom{12}{-7}$$

Find the value of x

Worked Example

Given that:

$$y \begin{pmatrix} -3 \\ -4 \end{pmatrix} + 4 \begin{pmatrix} 2 \\ 5 \end{pmatrix} = \begin{pmatrix} 2 \\ 12 \end{pmatrix}$$

Find the value of y

Your Turn

Given that:

$$3 \begin{pmatrix} -2 \\ y \end{pmatrix} - 2 \begin{pmatrix} y \\ 6 \end{pmatrix} = \begin{pmatrix} -16 \\ 3 \end{pmatrix}$$

Find the value of y

Worked Example

Given that:

$$\mathbf{b} = \begin{pmatrix} -3 \\ 5 \end{pmatrix}$$

$$\mathbf{c} = \begin{pmatrix} 2 \\ -2 \end{pmatrix}$$

$$\mathbf{f} = \begin{pmatrix} -3 \\ 9 \end{pmatrix}$$

Find the value of k such that:

$$k(\mathbf{b} + \mathbf{c}) = \mathbf{f}$$

Your Turn

Given that:

$$\mathbf{p} = \begin{pmatrix} 8 \\ -2 \end{pmatrix}$$

$$\mathbf{q} = \begin{pmatrix} 6 \\ 4 \end{pmatrix}$$

$$\mathbf{r} = \begin{pmatrix} 4 \\ -12 \end{pmatrix}$$

Find the value of m such that:

$$m(\mathbf{p} - \mathbf{q}) = \mathbf{r}$$

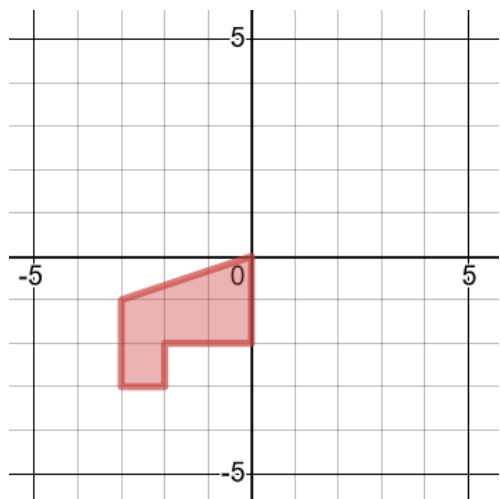
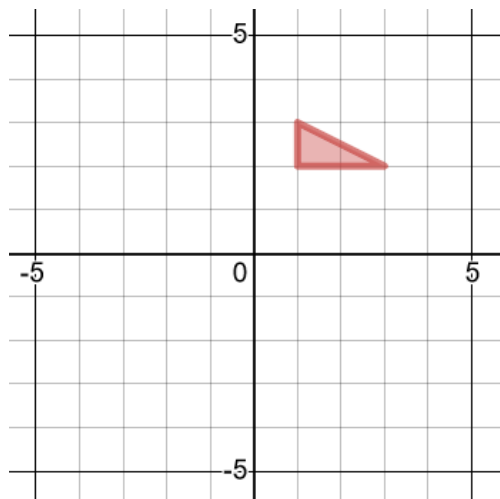
Extra Notes

4 Transformations

Reflections

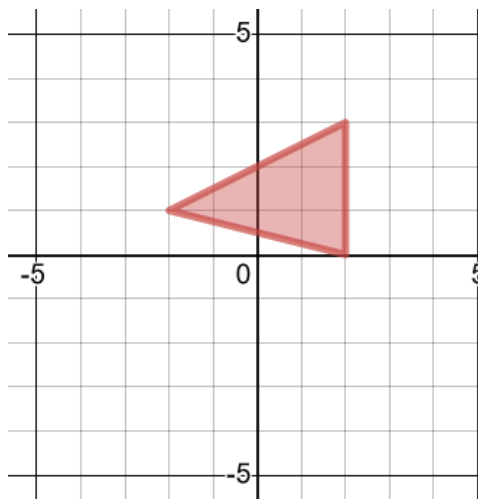
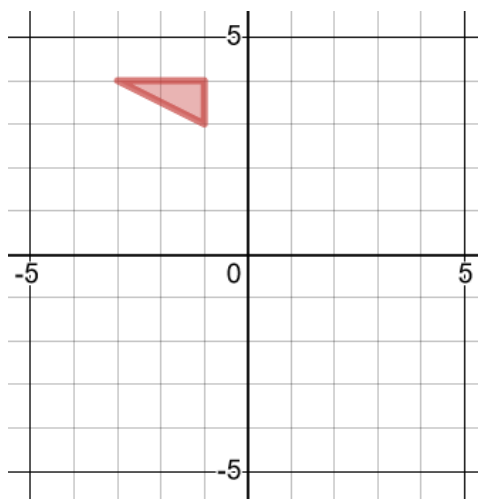
Worked Example

Reflect in the x -axis



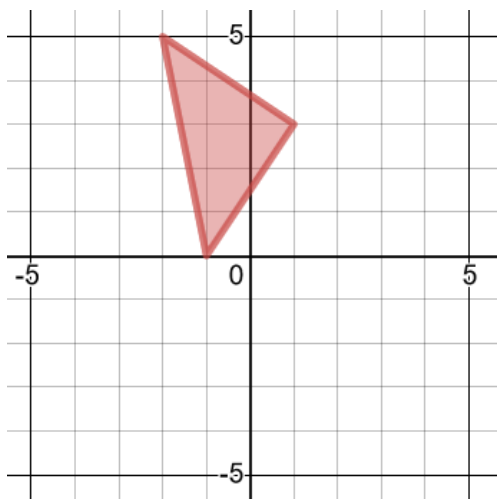
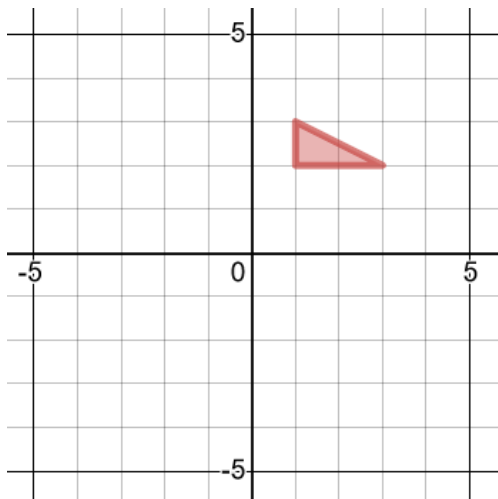
Your Turn

Reflect in the x -axis



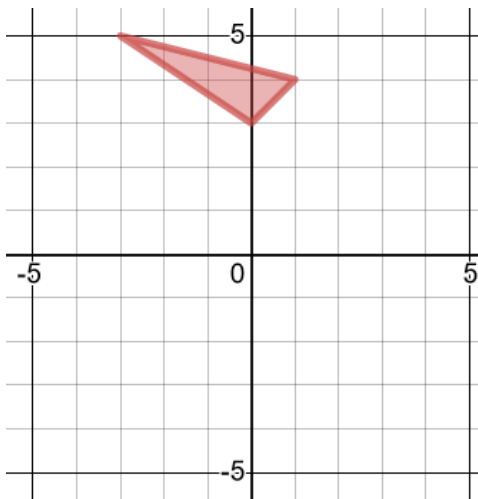
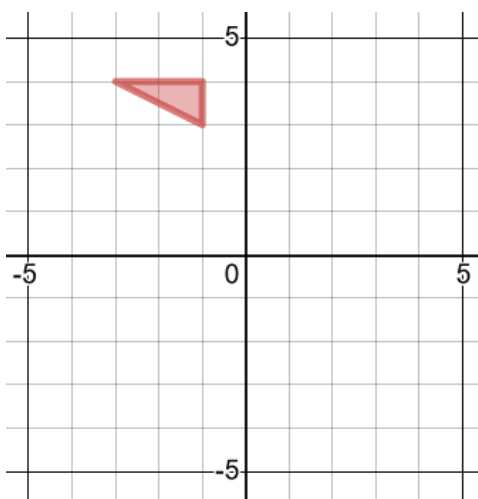
Worked Example

Reflect in the y -axis



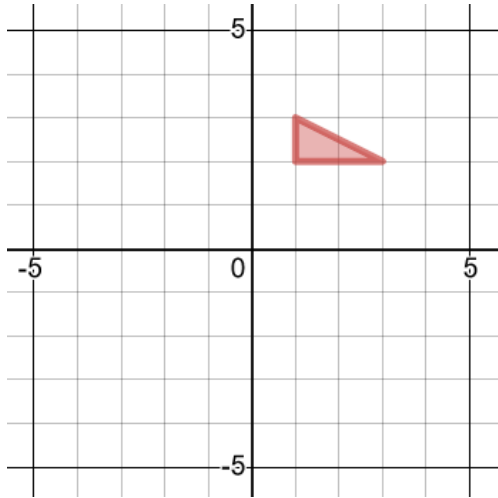
Your Turn

Reflect in the y -axis

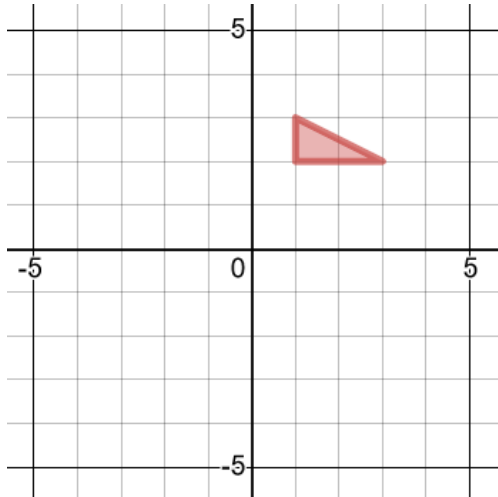


Worked Example

Reflect in the line $y = 1$

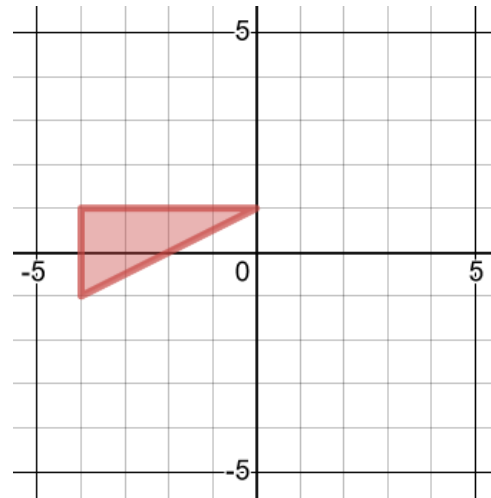


Reflect in the line $x = 3$

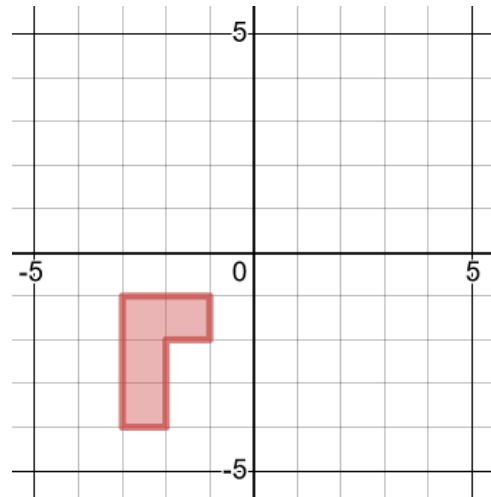


Your Turn

Reflect in the line $y = 2$

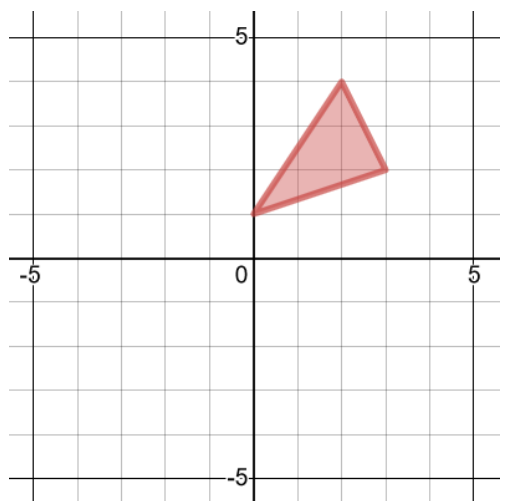
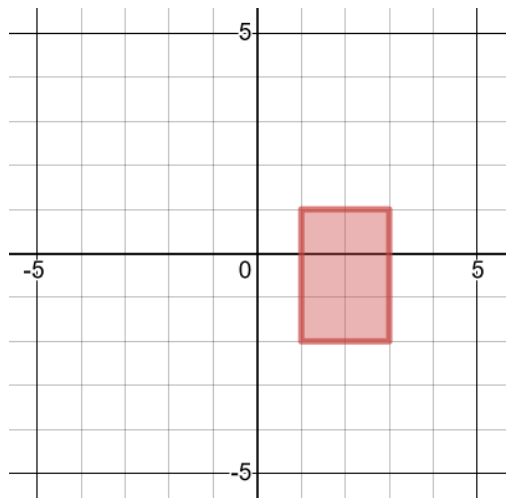


Reflect in the line $x = 1$



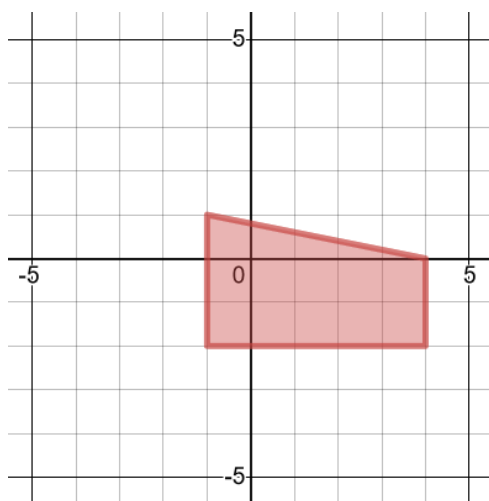
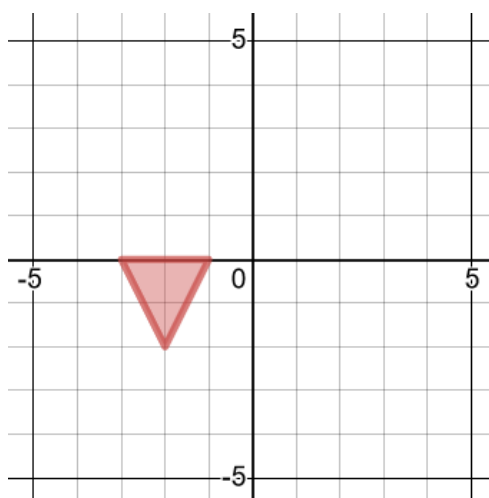
Worked Example

Reflect in the line $y = x$



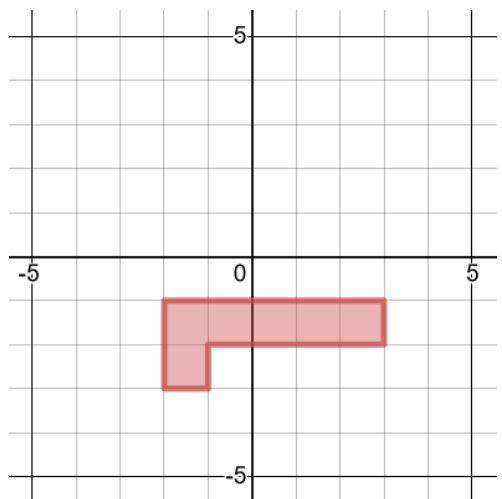
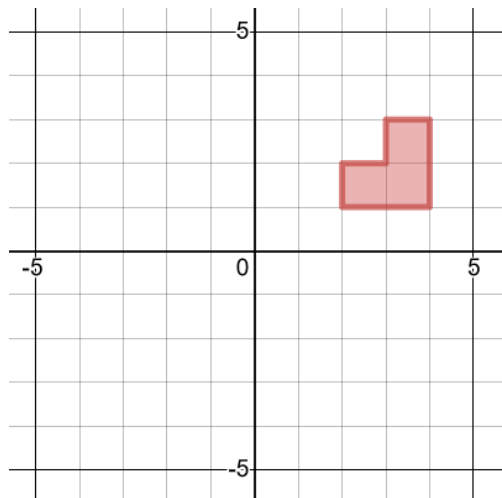
Your Turn

Reflect in the line $y = x$



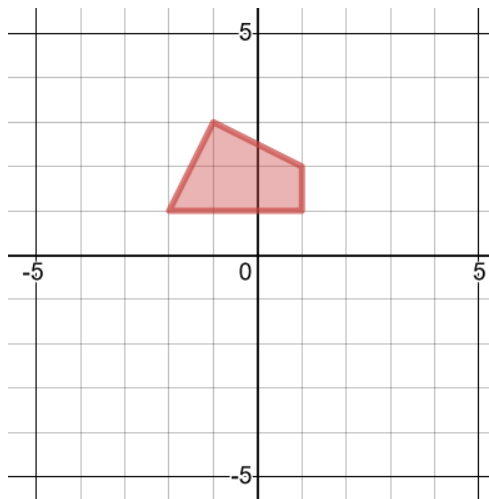
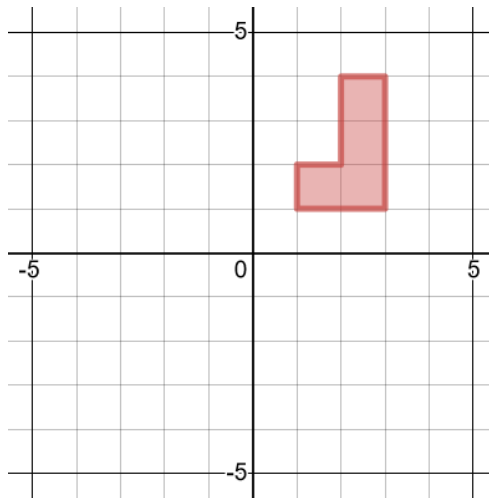
Worked Example

Reflect in the line $y = -x$



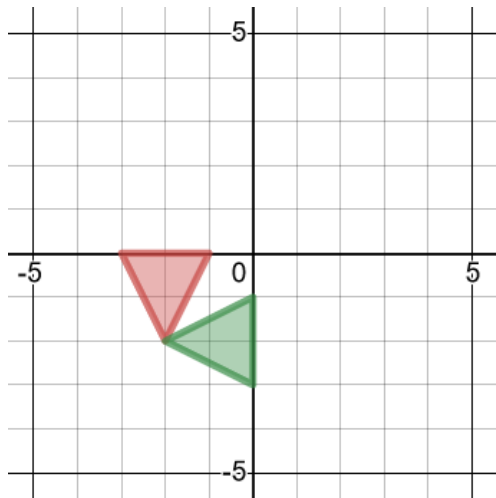
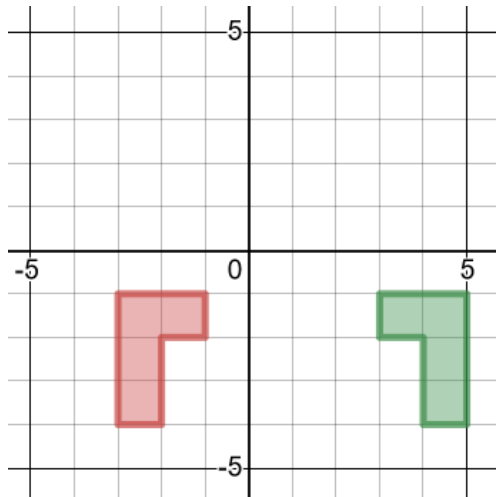
Your Turn

Reflect in the line $y = -x$



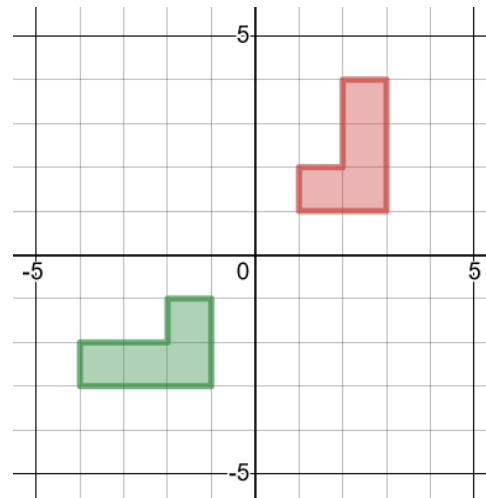
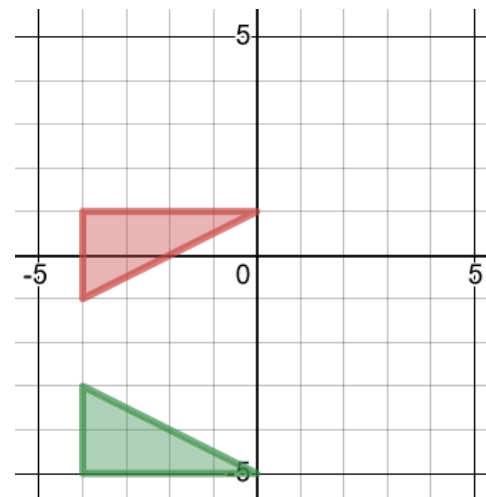
Worked Example

Describe the single transformation of the red object onto the green image



Your Turn

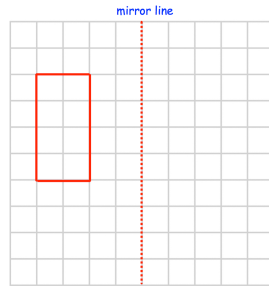
Describe the single transformation of the red object onto the green image



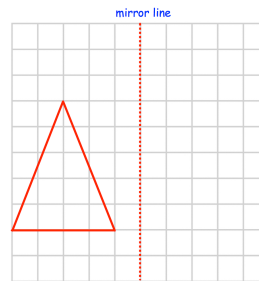
Fluency Practice

Question 1: Reflect each shape in the mirror line given

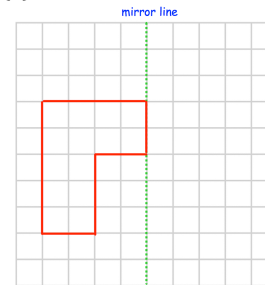
(a)



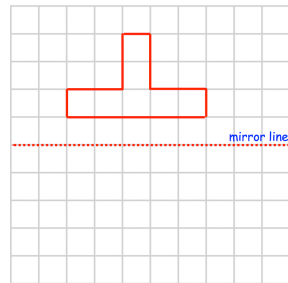
(b)



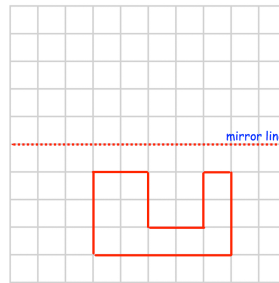
(c)



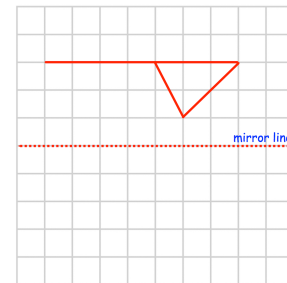
(d)



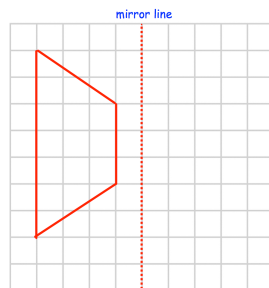
(e)



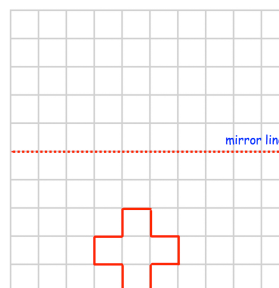
(f)



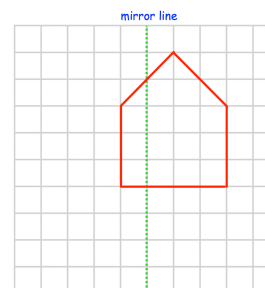
(g)



(h)

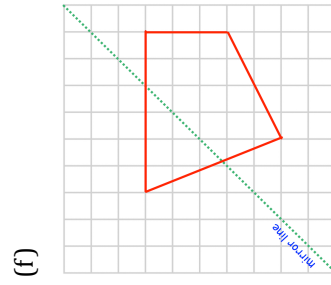
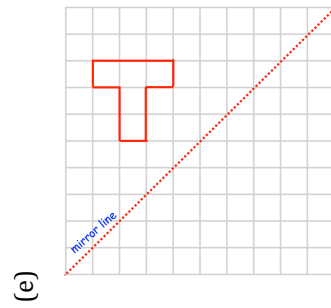
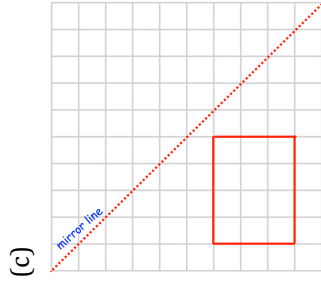
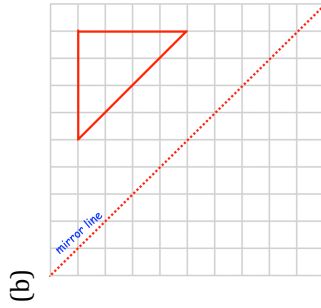
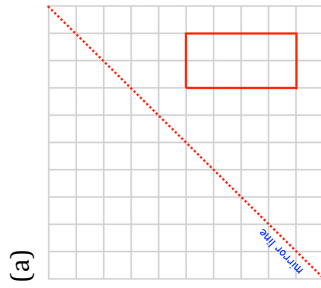


(i)

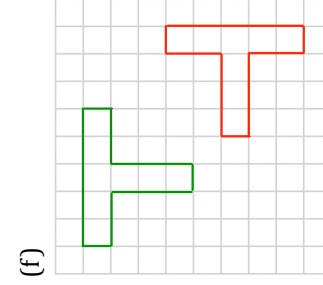
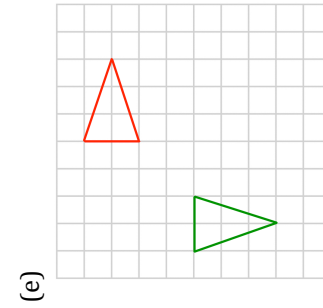
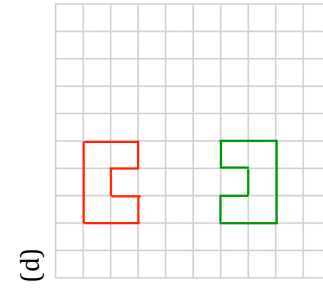
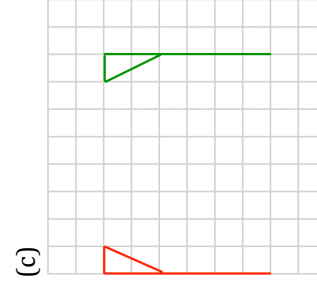
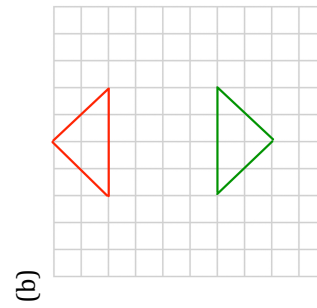
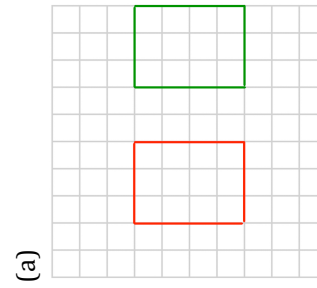


Fluency Practice

Question 2: Reflect each shape in the mirror line given



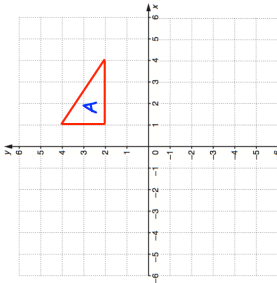
Question 3: Find the mirror line for each of the reflections below.



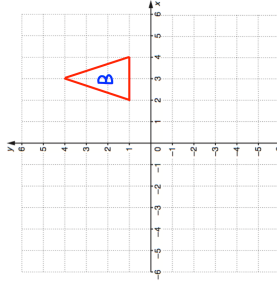
Fluency Practice

Question 4:

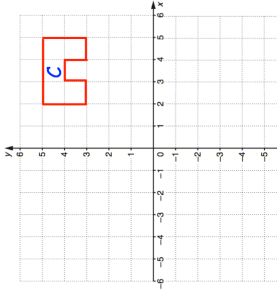
(a) Reflect triangle A in the x-axis



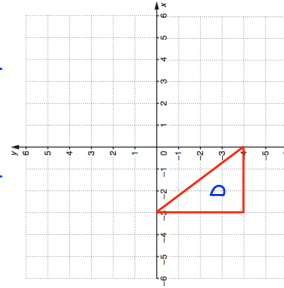
(b) Reflect triangle B in the y-axis



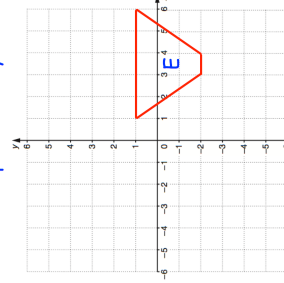
(c) Reflect shape C in the x-axis



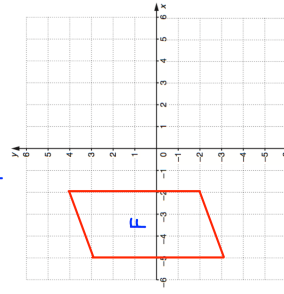
(d) Reflect shape D in the y-axis



(e) Reflect shape E in the y-axis

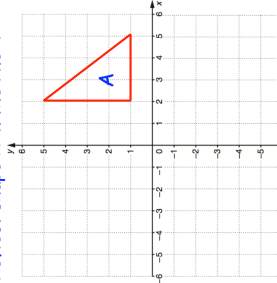


(f) Reflect shape F in the x-axis

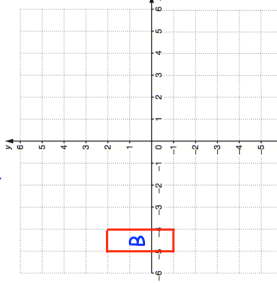


Question 5:

(a) Reflect shape A in the line $x = 1$



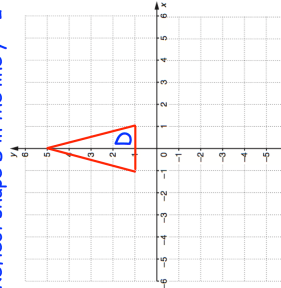
(b) Reflect shape B in the line $x = -2$



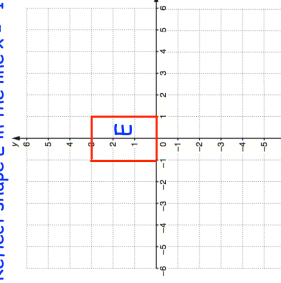
(c) Reflect shape C in the line $y = -1$



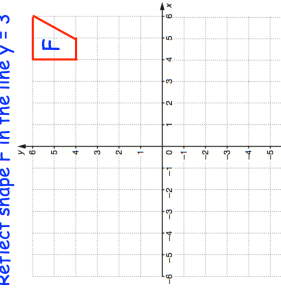
(d) Reflect shape D in the line $y = 2$



(e) Reflect shape E in the line $x = -1$



(f) Reflect shape F in the line $y = 3$

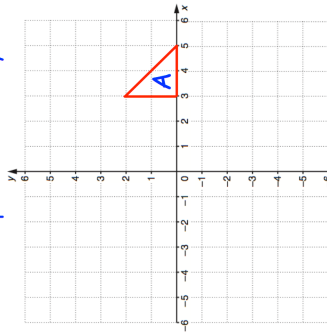


Fluency Practice

Question 6:

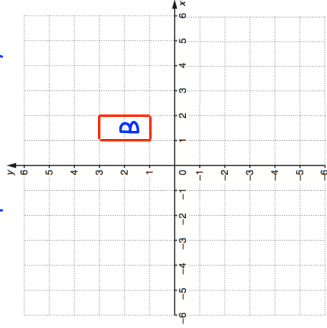
(a)

Reflect shape A in the line $y = x$



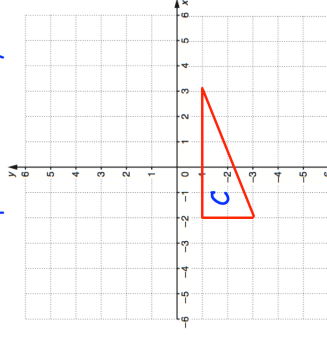
(b)

Reflect shape B in the line $y = -x$



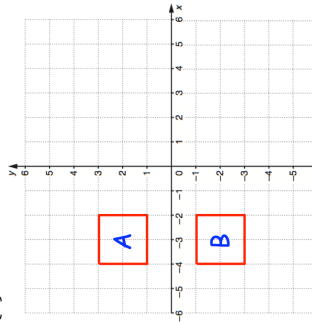
(c)

Reflect shape C in the line $y = x$

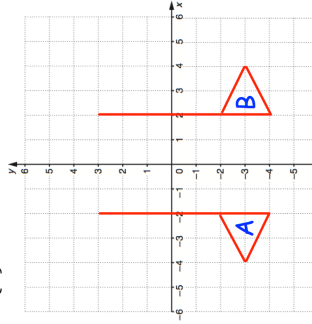


Question 7: Describe fully the single transformation that takes shape A to shape B.

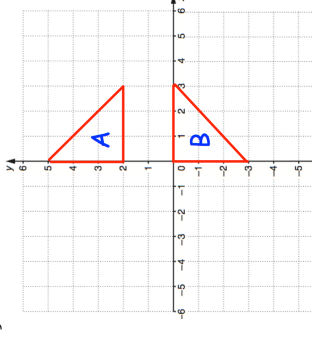
(a)



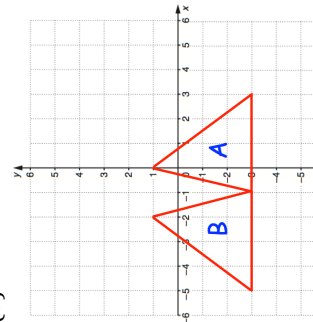
(b)



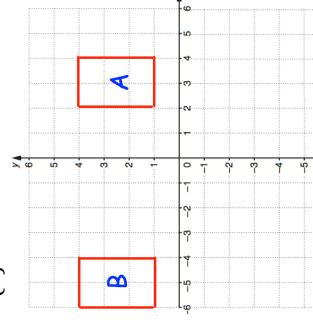
(c)



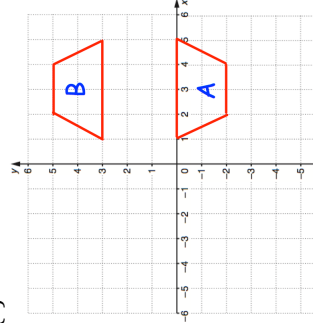
(d)



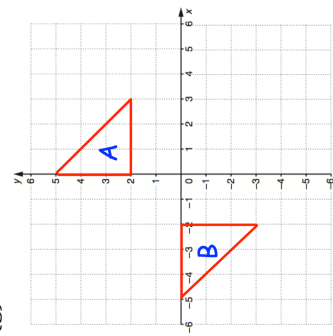
(e)



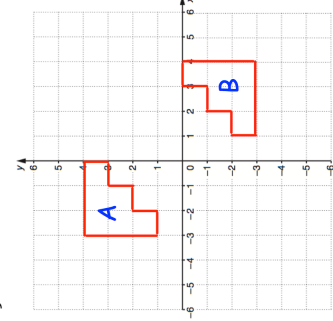
(f)



(g)



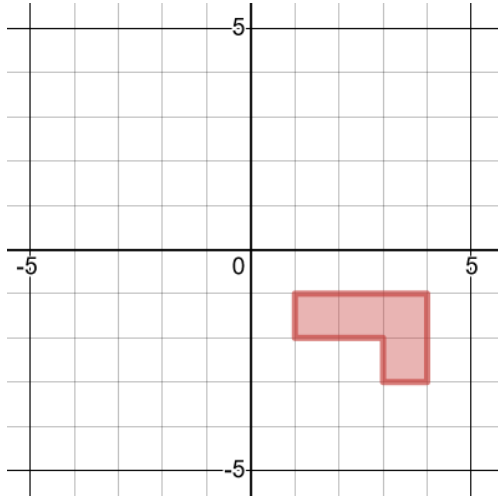
(h)



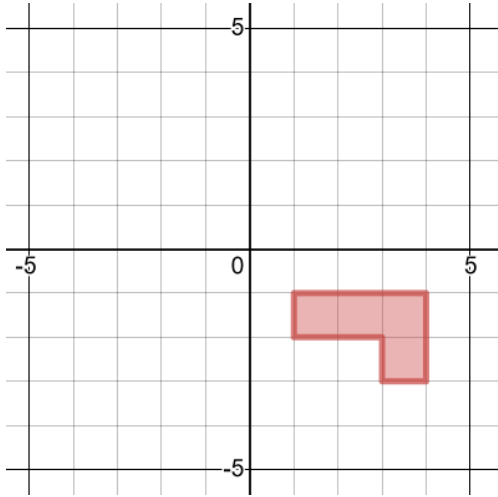
Rotations

Worked Example

Rotate 90° clockwise about the origin

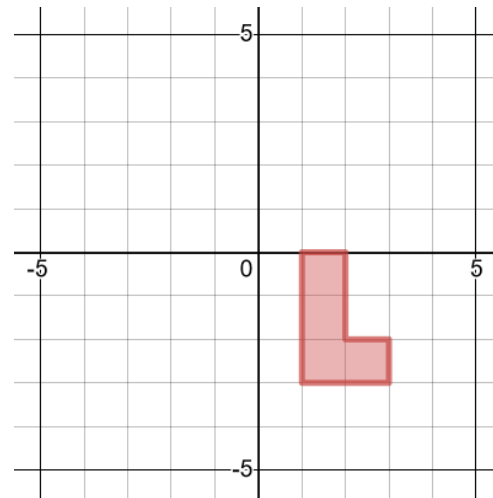


Rotate 90° anticlockwise about the origin

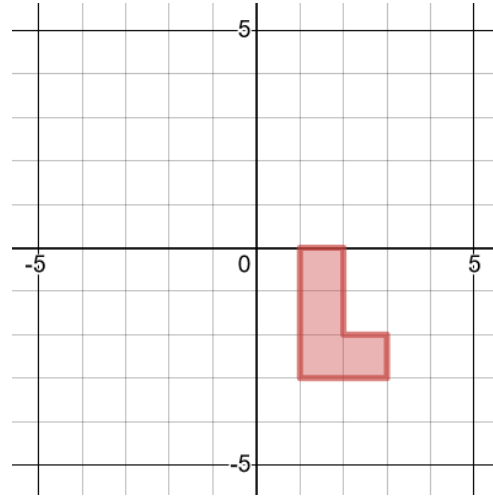


Your Turn

Rotate 90° clockwise about the origin

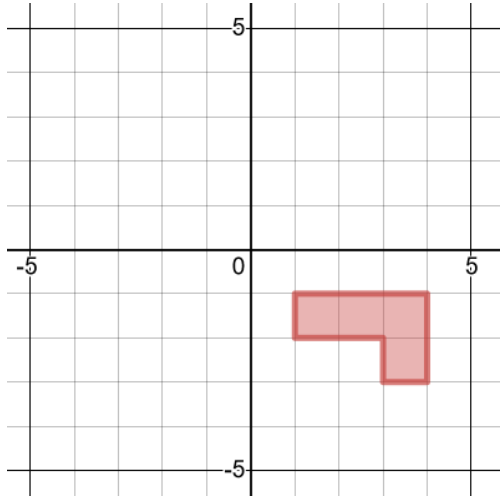


Rotate 90° anticlockwise about the origin

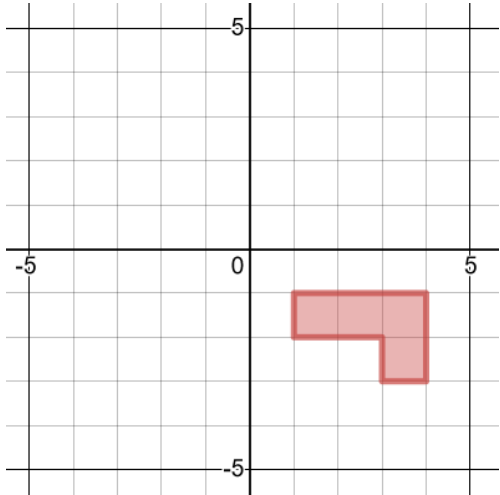


Worked Example

Rotate 90° clockwise about $(1, -1)$

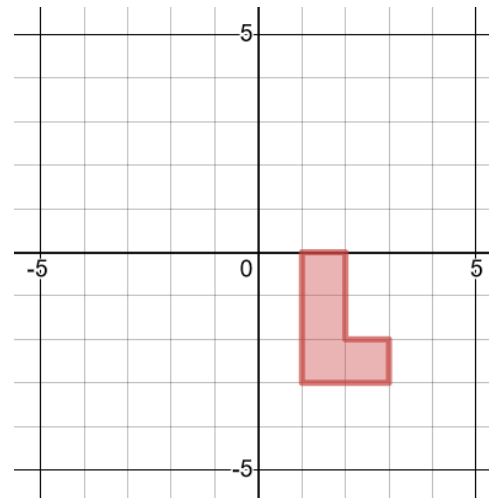


Rotate 90° anticlockwise about $(1, -1)$

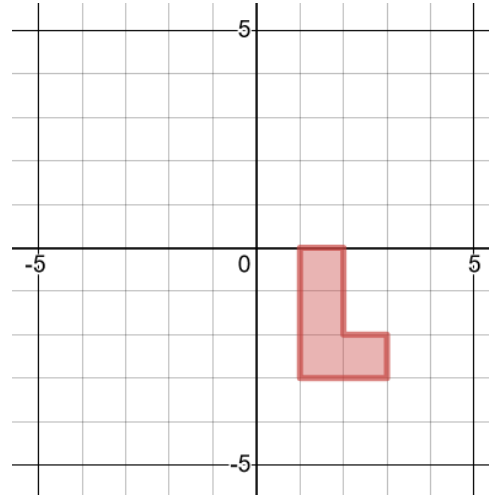


Your Turn

Rotate 90° clockwise about $(1, -1)$

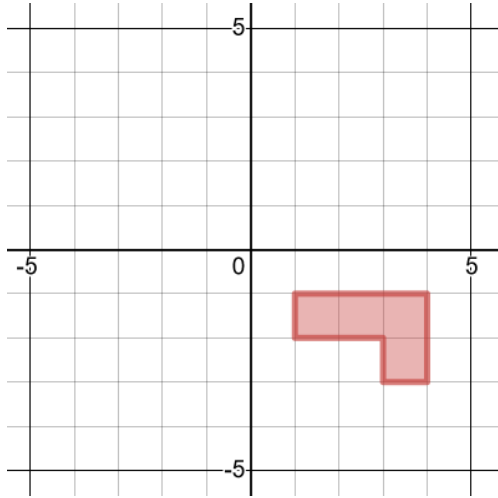


Rotate 90° anticlockwise about $(1, -1)$

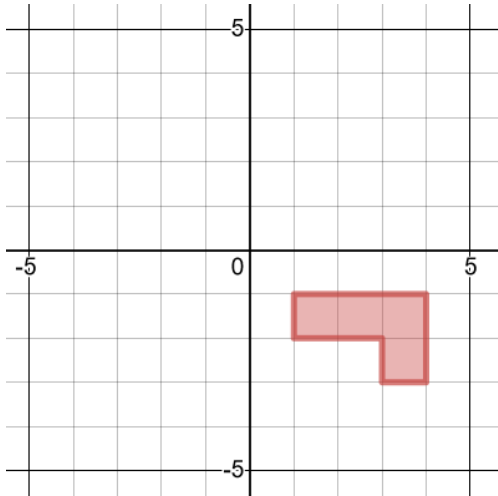


Worked Example

Rotate 180° about the origin

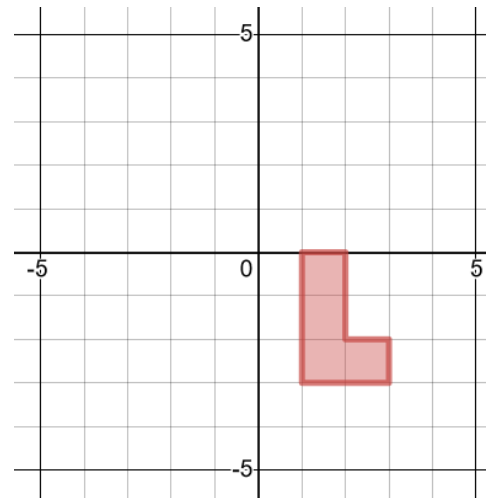


Rotate 180° about $(1, -1)$

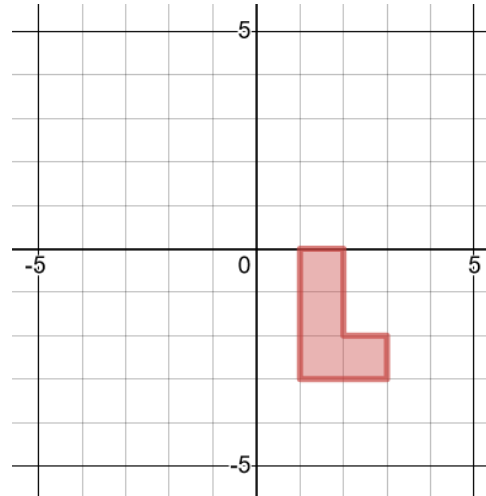


Your Turn

Rotate 180° about the origin

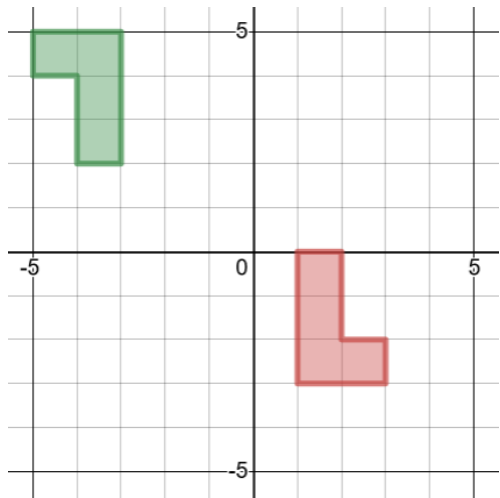
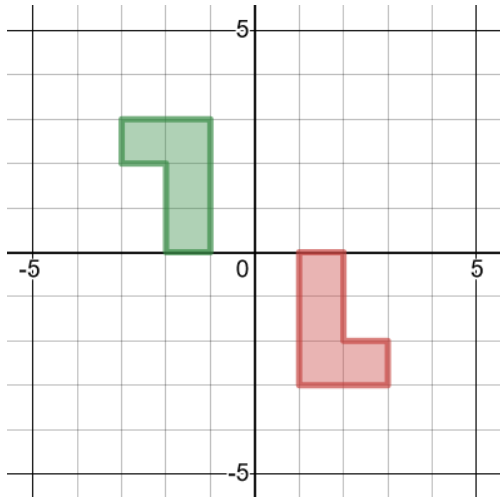


Rotate 180° about $(1, -1)$



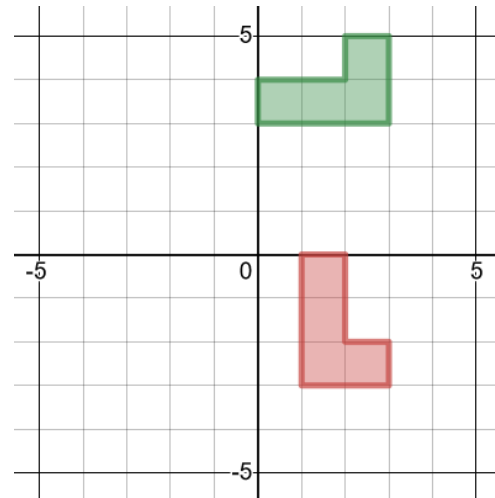
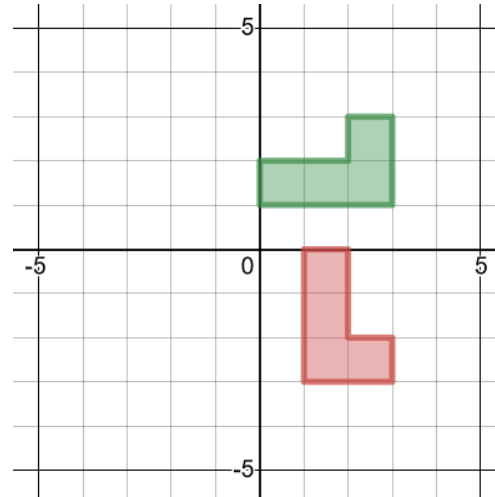
Worked Example

Describe the single transformation of the red object onto the green image.



Your Turn

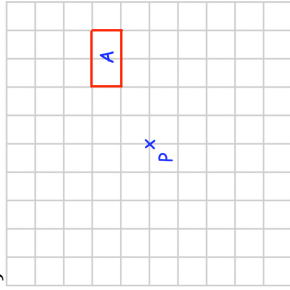
Describe the single transformation of the red object onto the green image.



Fluency Practice

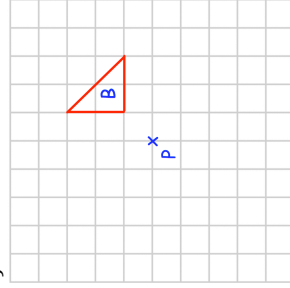
Question 1: Rotate each of the shapes below as instructed, using P as the centre of rotation.

(a)



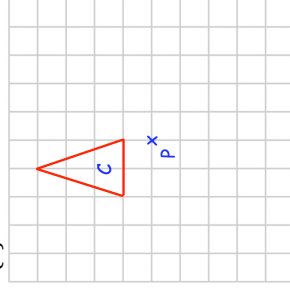
rotate 90° clockwise about P

(b)



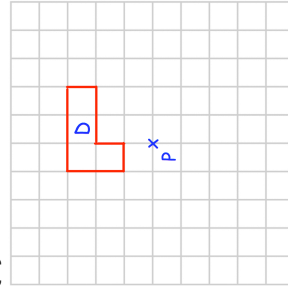
rotate 90° anticlockwise about P

(c)



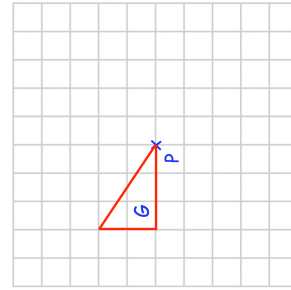
rotate 90° clockwise about P

(d)



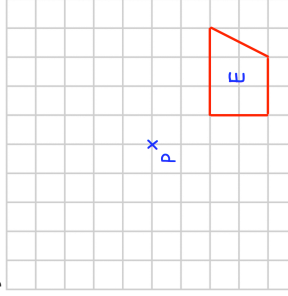
rotate 180° about P

(g)



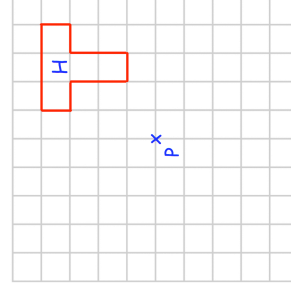
rotate 90° clockwise about P

(e)



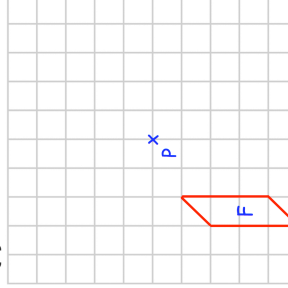
rotate 90° anticlockwise about P

(h)



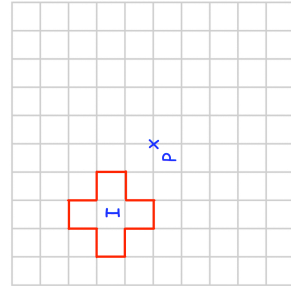
rotate 270° clockwise about P

(f)



rotate 180° about P

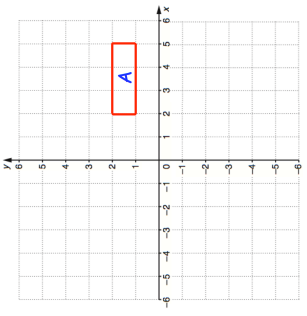
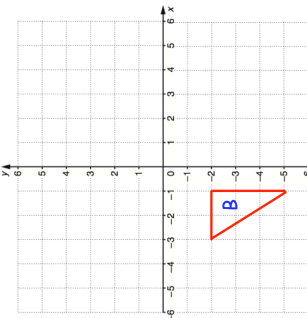
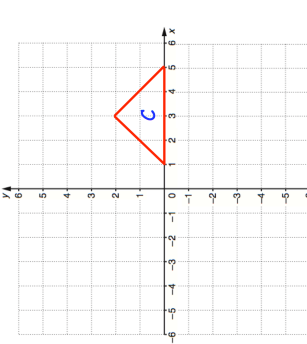
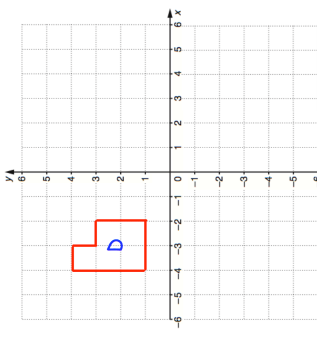
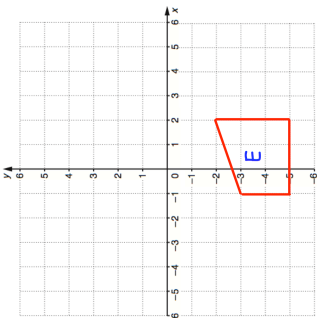
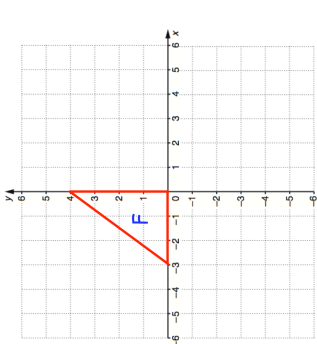
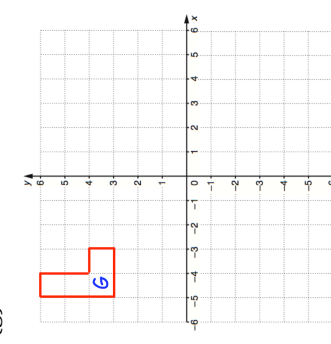
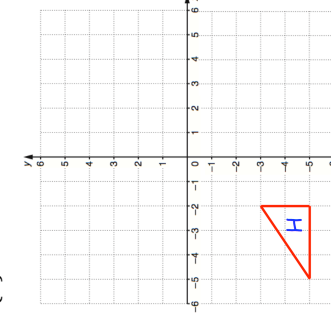
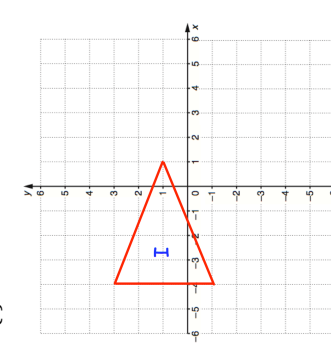
(i)



rotate 270° anticlockwise about P

Fluency Practice

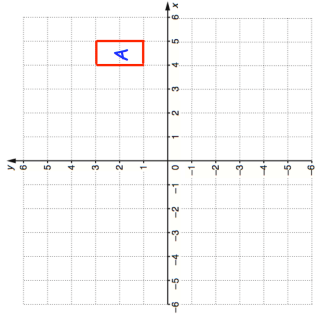
Question 2: Rotate each of the shapes below as instructed, using the origin, (0,0), as the centre of rotation.

(a) 	(b) 	(c) 
rotate 180° about (0, 0)	rotate 90° clockwise about (0, 0)	rotate 90° anticlockwise about (0, 0)
(d) 	(e) 	(f) 
rotate 90° clockwise about (0, 0)	rotate 90° anticlockwise about (0, 0)	rotate 180° about (0, 0)
(g) 	(h) 	(i) 
rotate 90° anticlockwise about (0, 0)	rotate 180° about (0, 0)	rotate 90° clockwise about (0, 0)

Fluency Practice

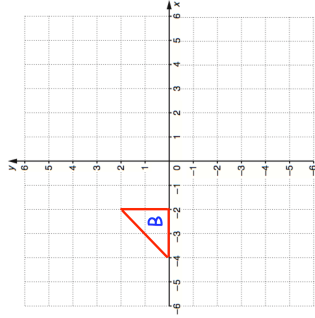
Question 3: Rotate each of the shapes below as instructed.

(a)



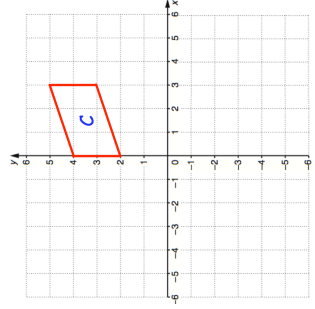
rotate 90° anticlockwise about $(0, 1)$

(b)



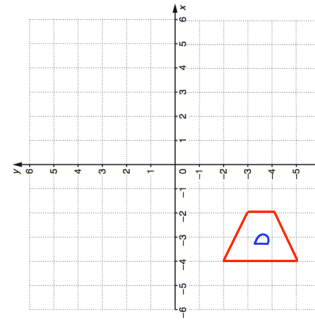
rotate 90° clockwise about $(-1, -2)$

(c)



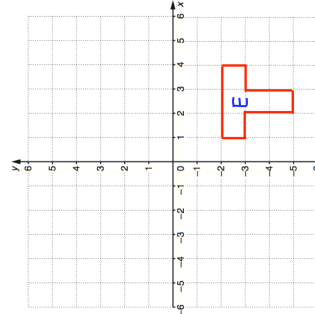
rotate 180° about $(1, 1)$

(d)



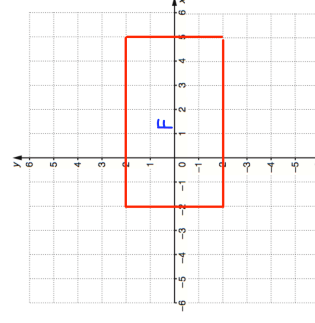
rotate 90° anticlockwise about $(-4, 0)$

(e)



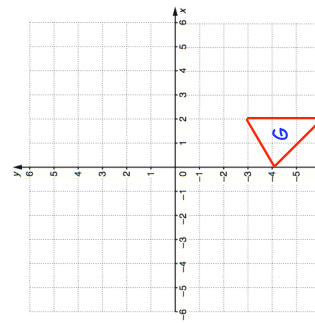
rotate 180° about $(-1, 0)$

(f)



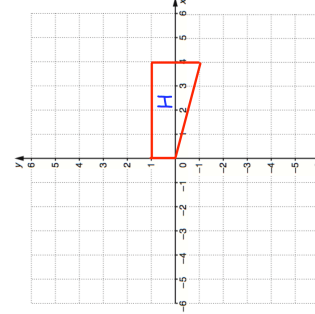
rotate 90° clockwise about $(-1, 2)$

(g)



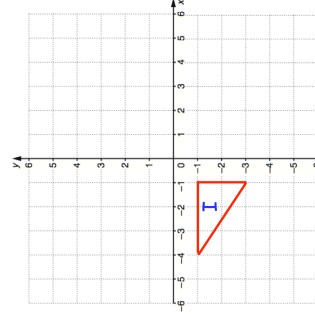
rotate 90° clockwise about $(5, 0)$

(h)



rotate 90° anticlockwise about $(3, 0)$

(i)

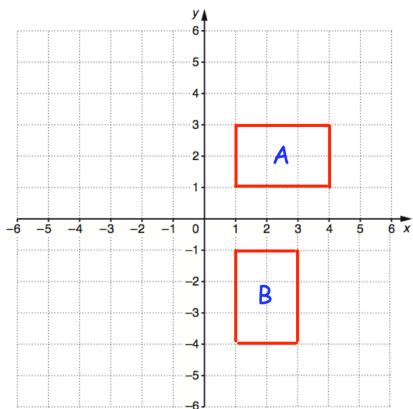


rotate 180° about $(1, 1)$

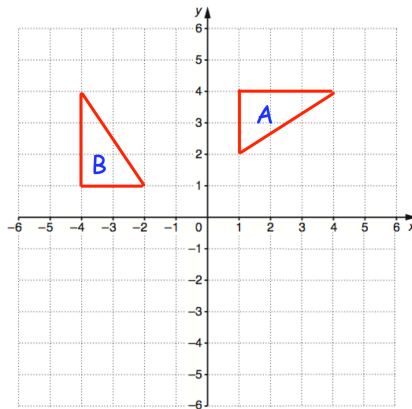
Fluency Practice

Question 4: Describe fully the single transformation that takes shape A to shape B.

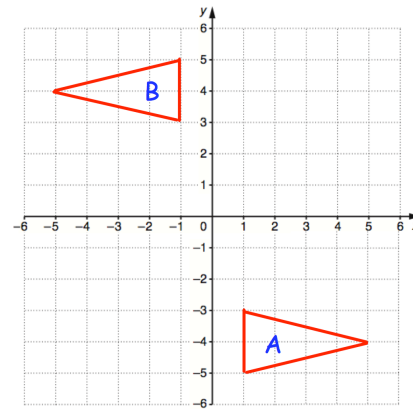
(a)



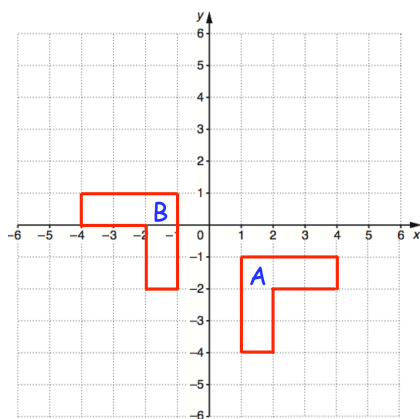
(b)



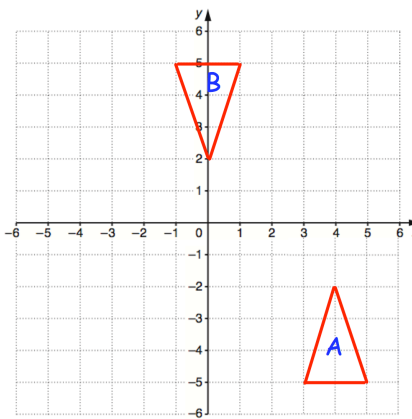
(c)



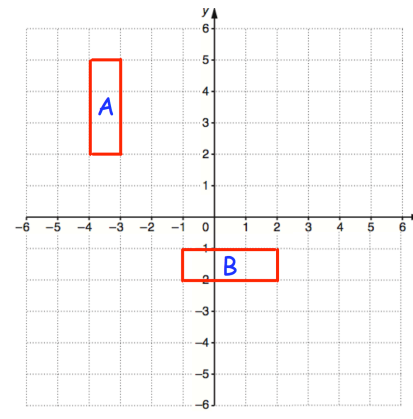
(d)



(e)



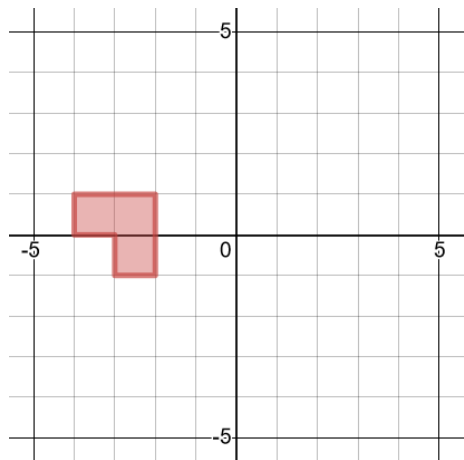
(f)



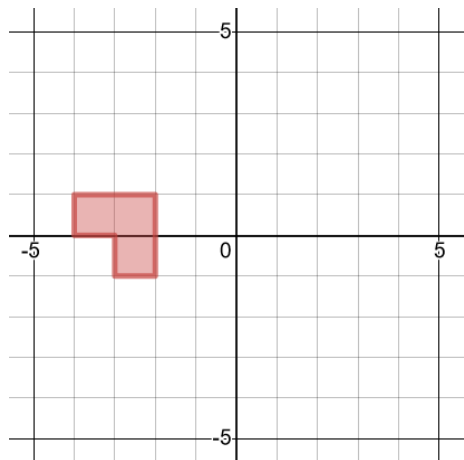
Translations

Worked Example

Translate by vector $\begin{pmatrix} 3 \\ 2 \end{pmatrix}$

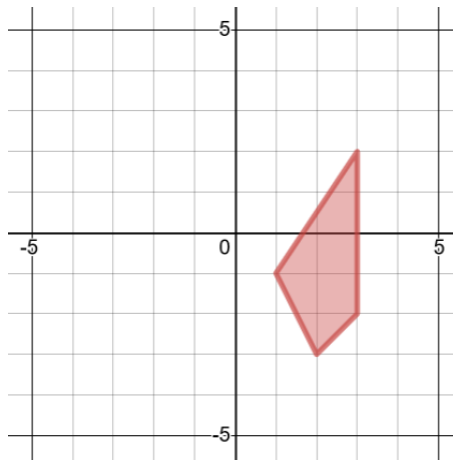


Translate by vector $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$

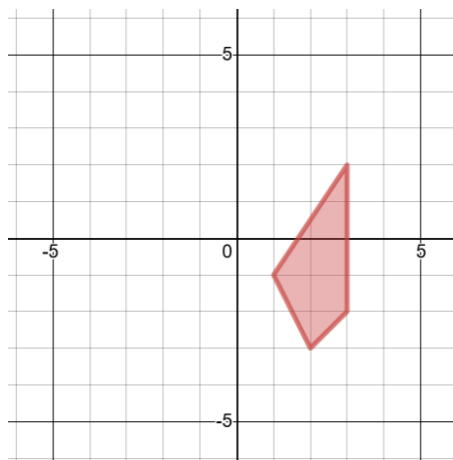


Your Turn

Translate by vector $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$

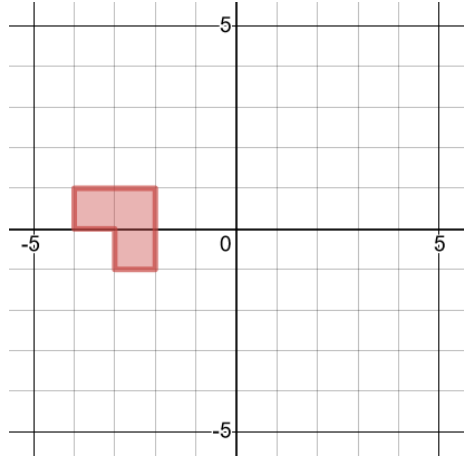


Translate by vector $\begin{pmatrix} 3 \\ -2 \end{pmatrix}$

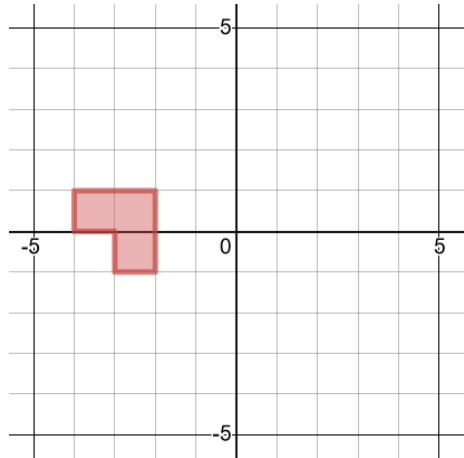


Worked Example

Translate by vector $\begin{pmatrix} -2 \\ -3 \end{pmatrix}$

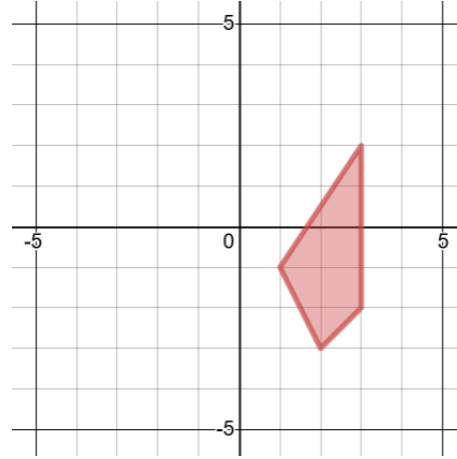


Translate by vector $\begin{pmatrix} 3 \\ -2 \end{pmatrix}$ and then by vector $\begin{pmatrix} -4 \\ 5 \end{pmatrix}$

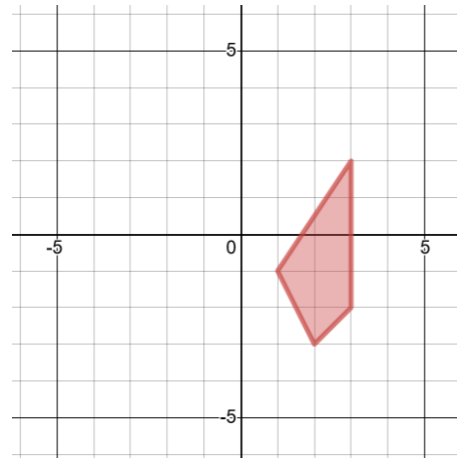


Your Turn

Translate by vector $\begin{pmatrix} -3 \\ -2 \end{pmatrix}$

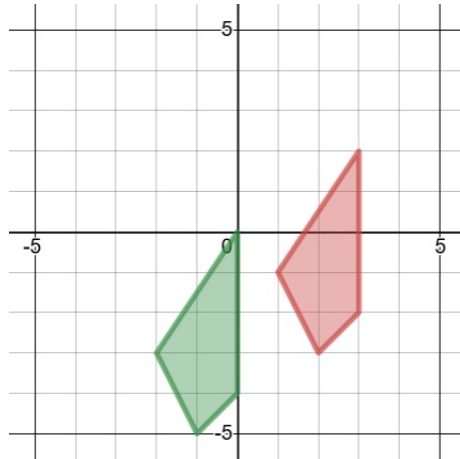
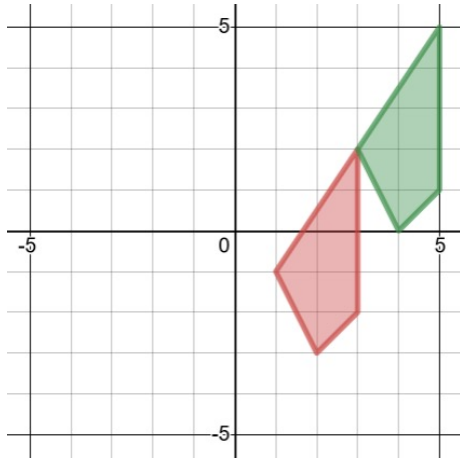


Translate by vector $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$ and then by vector $\begin{pmatrix} -5 \\ 4 \end{pmatrix}$



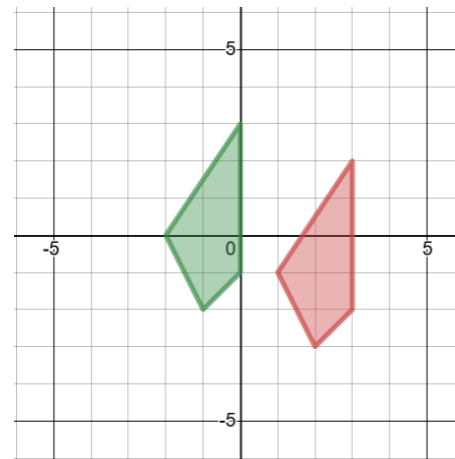
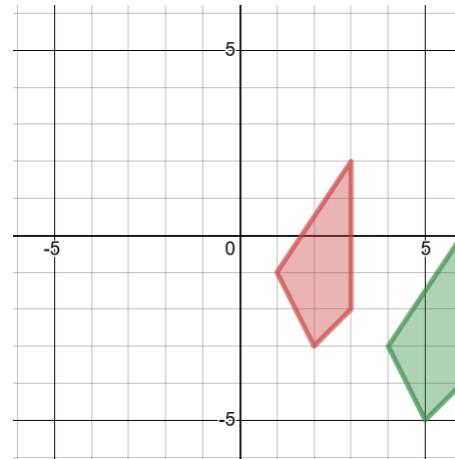
Worked Example

Describe the single transformation of the red object onto the green image.



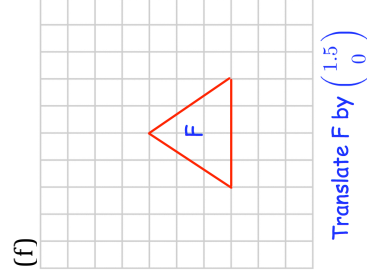
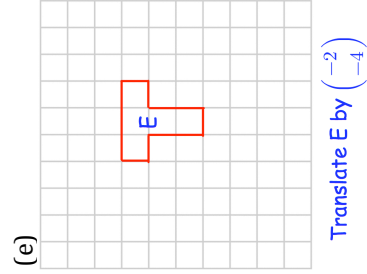
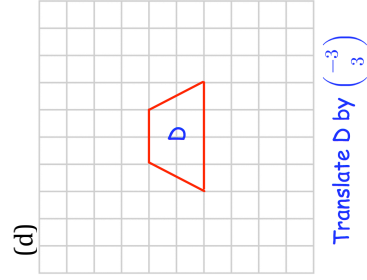
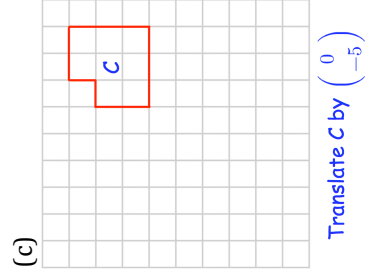
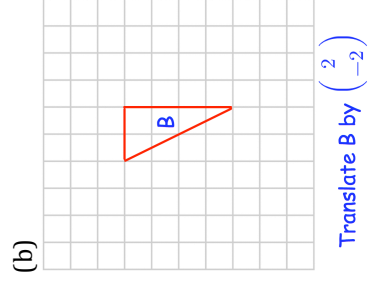
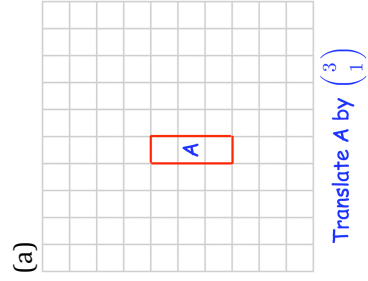
Your Turn

Describe the single transformation of the red object onto the green image.

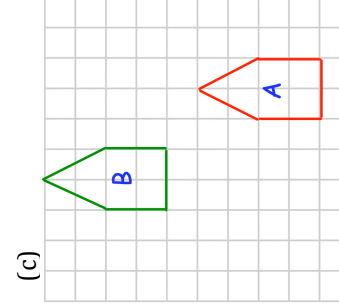
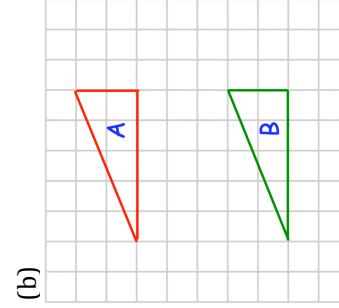
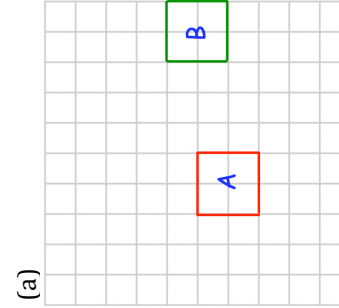


Fluency Practice

Question 1: Translate each of the shapes below as instructed.

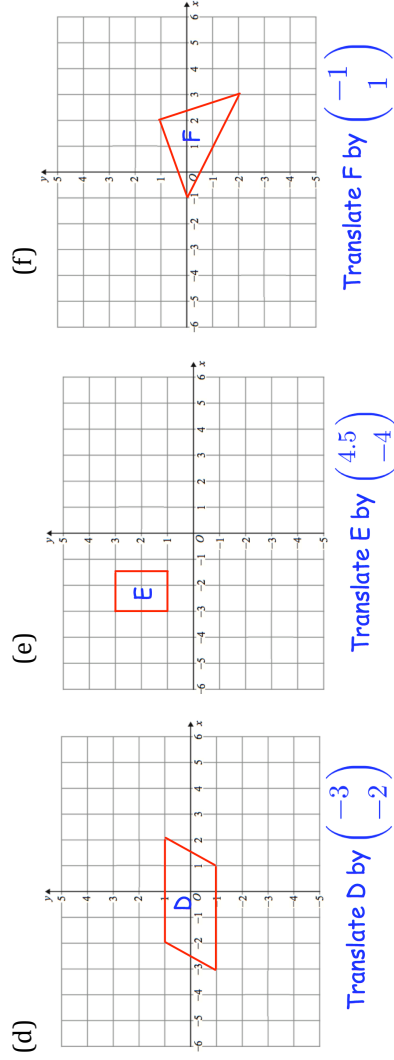
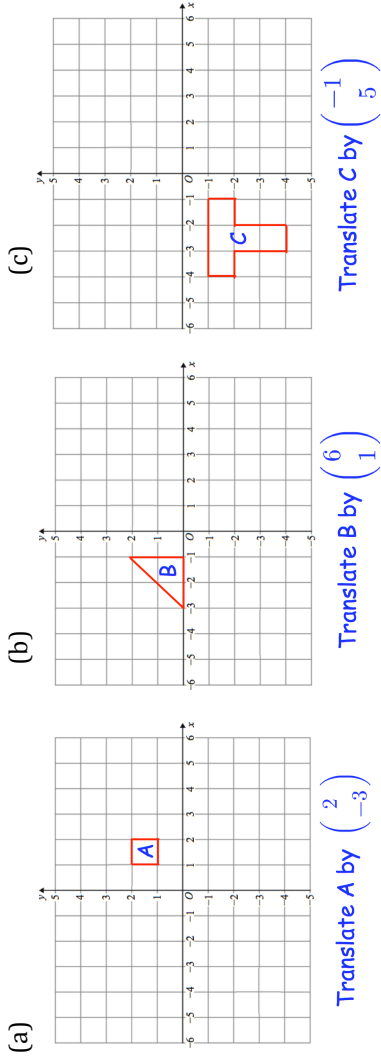


Question 2: Describe fully each translation that takes shape A to shape B

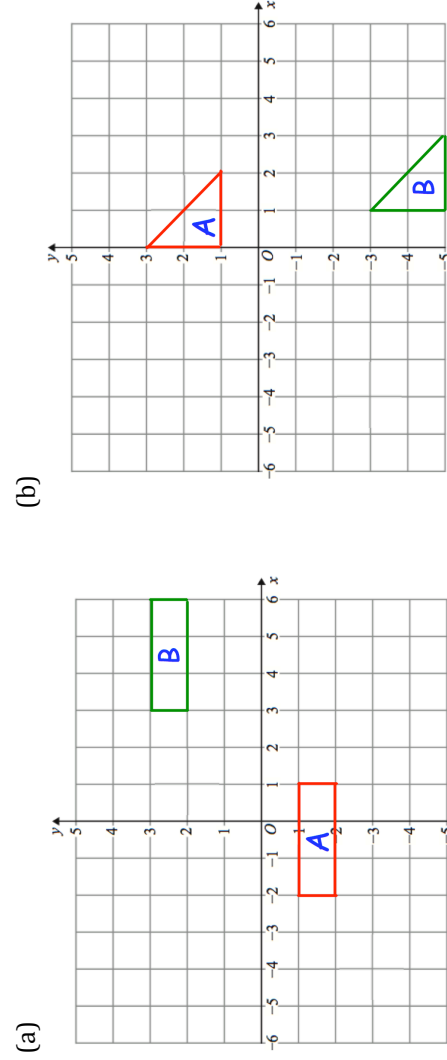


Fluency Practice

Question 3: Translate each of the shapes below as instructed.

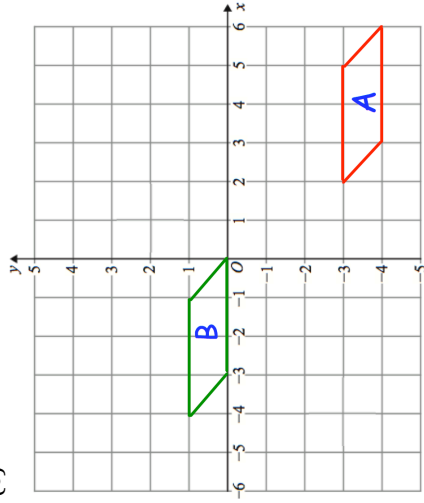


Question 4: Describe fully the single transformation that takes shape A to shape B

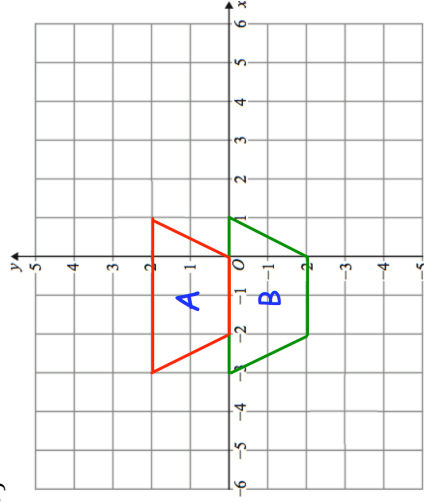


Fluency Practice

(c)



(d)

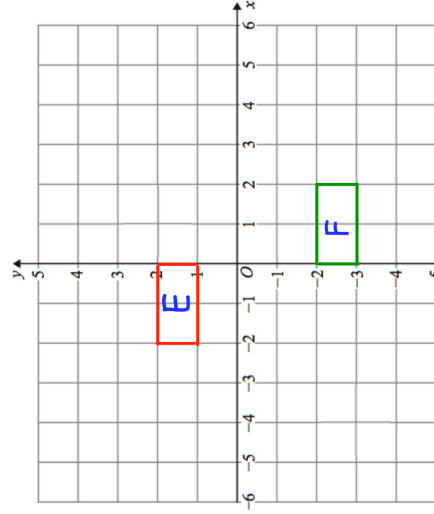


Question 5: The translation vector to take shape C to shape D is $\begin{pmatrix} 2 \\ -5 \end{pmatrix}$

What translation vector takes shape D to shape C?

Question 6: Edward has been asked to translate shape E by $\begin{pmatrix} -4 \\ 2 \end{pmatrix}$

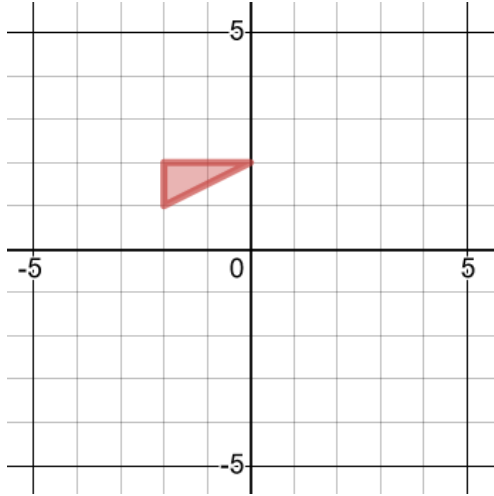
He has labelled his answer shape F
Can you spot any mistakes?



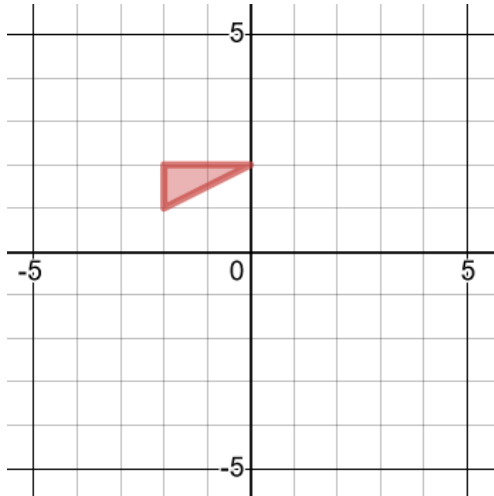
Enlargements

Worked Example

Enlarge about $(-4, 3)$, scale factor 2

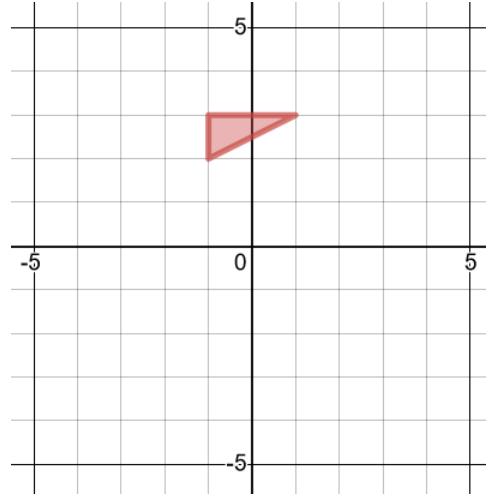


Enlarge about $(-2, 4)$, scale factor 3

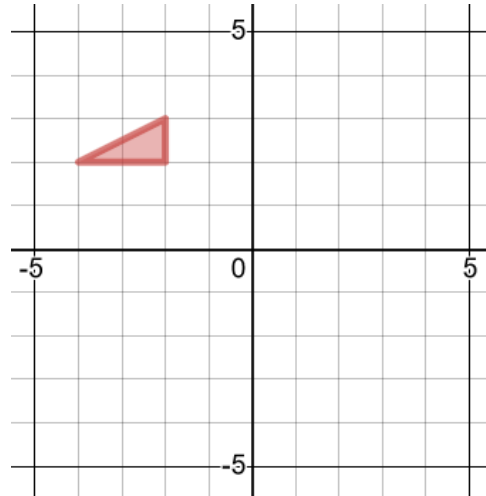


Your Turn

Enlarge about $(-3, 3)$, scale factor 2

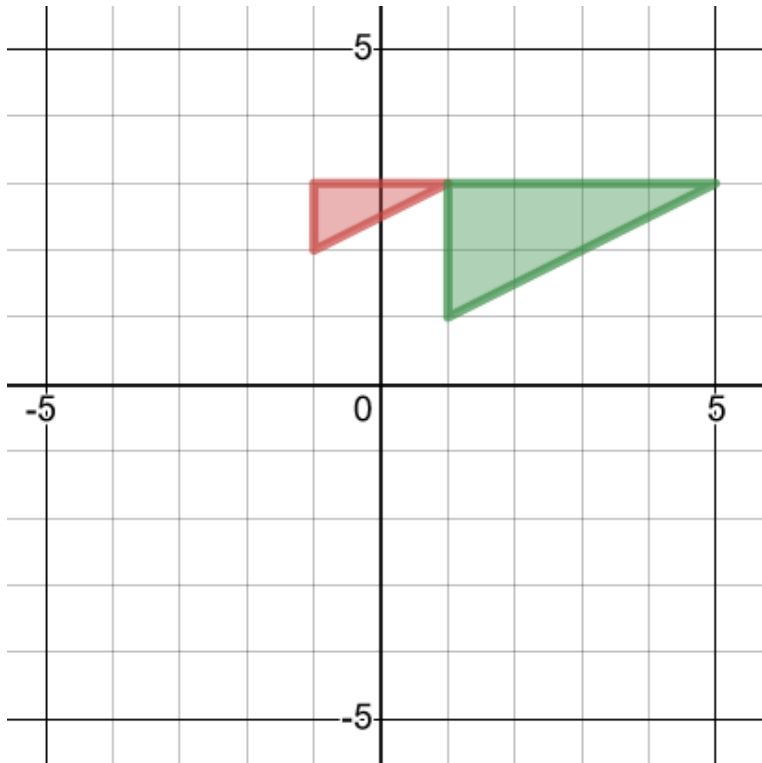


Enlarge about $(-4, 4)$, scale factor 3



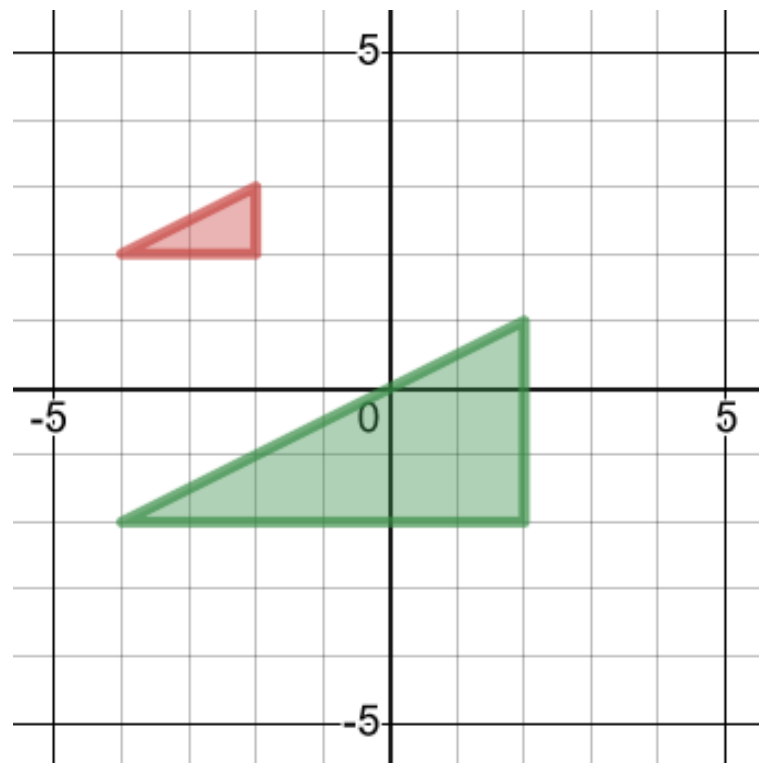
Worked Example

Describe the single transformation of the red object onto the green image



Your Turn

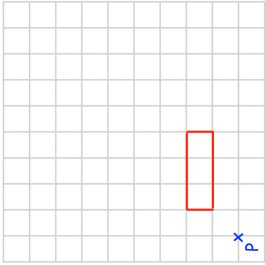
Describe the single transformation of the red object onto the green image



Fluency Practice

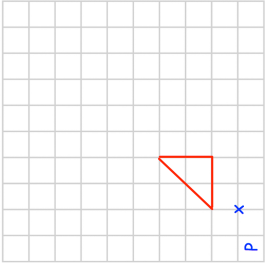
Question 1: Enlarge each shape by the scale factor given
Use P as the centre of enlargement.

(a)



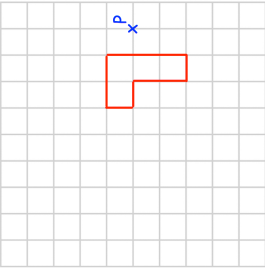
Enlarge by scale factor 2

(b)



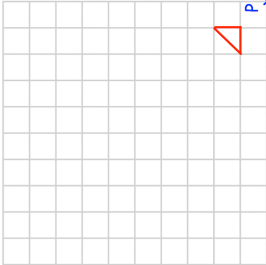
Enlarge by scale factor 3

(c)



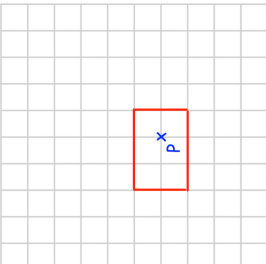
Enlarge by scale factor 2

(d)



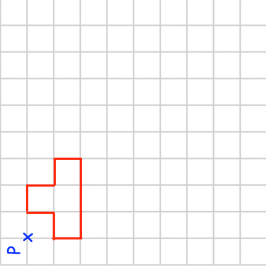
Enlarge by scale factor 4

(e)



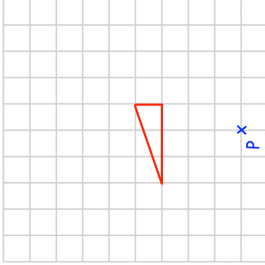
Enlarge by scale factor 2

(f)



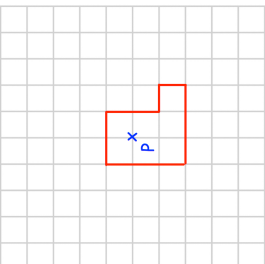
Enlarge by scale factor 3

(g)



Enlarge by scale factor 2

(h)

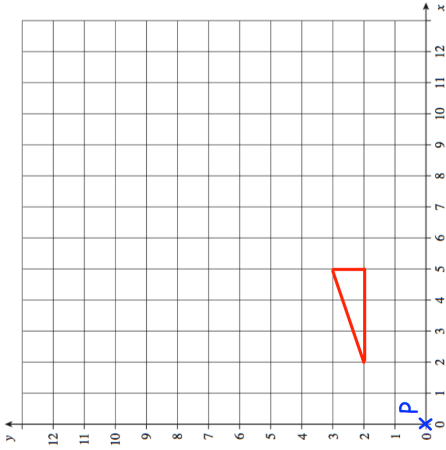


Enlarge by scale factor 2

Fluency Practice

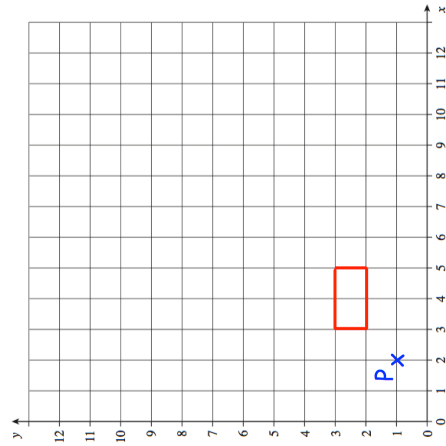
Question 2: Enlarge each shape by the scale factor given
Use P as the centre of enlargement.

(a)



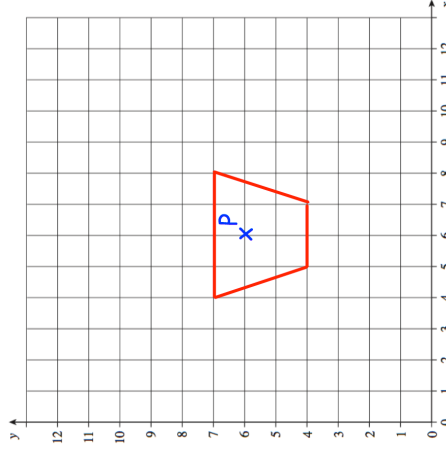
Enlarge by scale factor 2

(b)



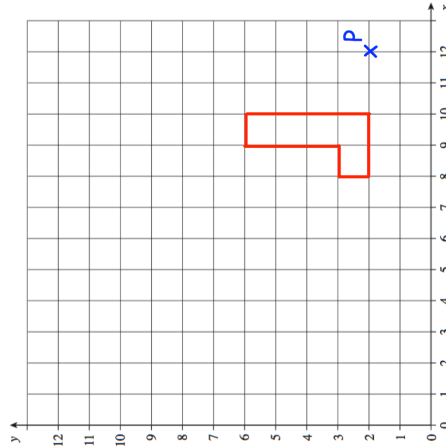
Enlarge by scale factor 3

(c)



Enlarge by scale factor 3

(d)

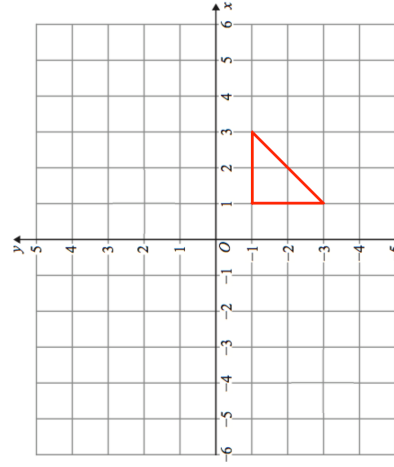


Enlarge by scale factor 2

Fluency Practice

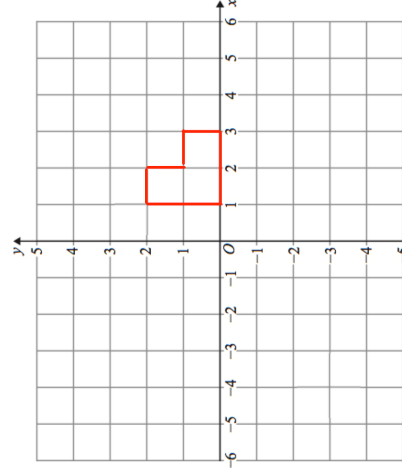
Question 3: Enlarge each shape by the scale factor given
The coordinates for each centre of enlargement are given.

(a)



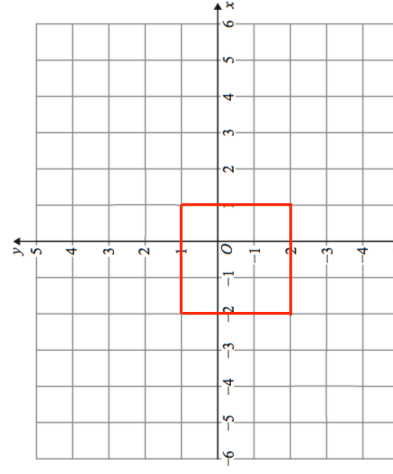
Enlarge by scale factor 2 using
(4, -3) as the centre of enlargement

(b)



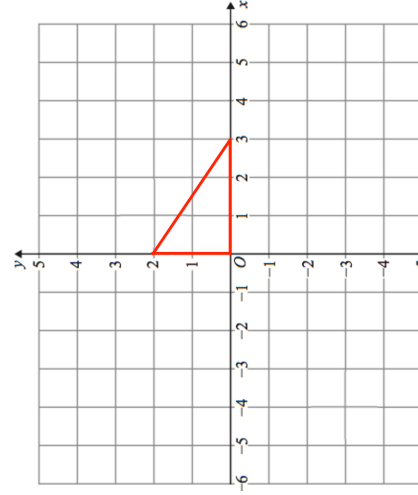
Enlarge by scale factor 3 using
(3, 2) as the centre of enlargement

(c)



Enlarge by scale factor 2 using
(0, -1) as the centre of enlargement

(d)

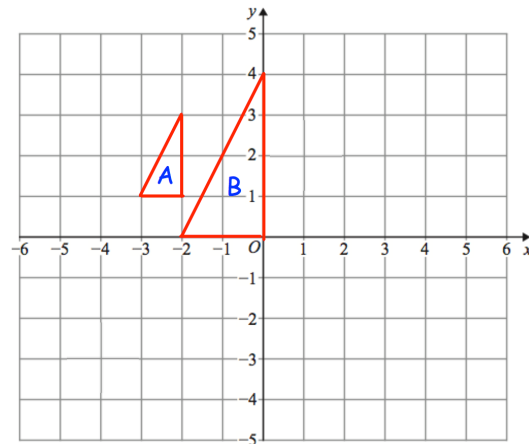


Enlarge by scale factor 2 using
the origin as the centre of enlargement

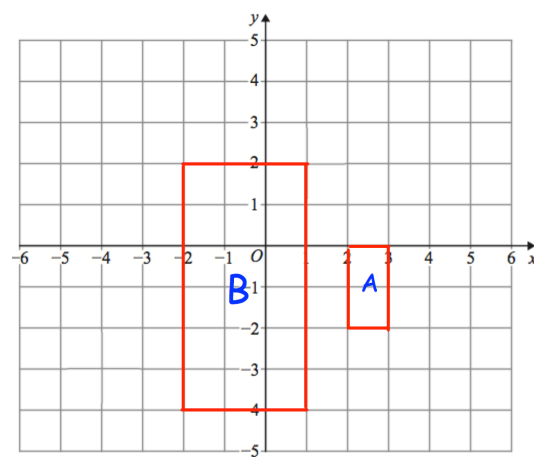
Fluency Practice

Question 4: Describe fully the single transformation that takes shape A to shape B.

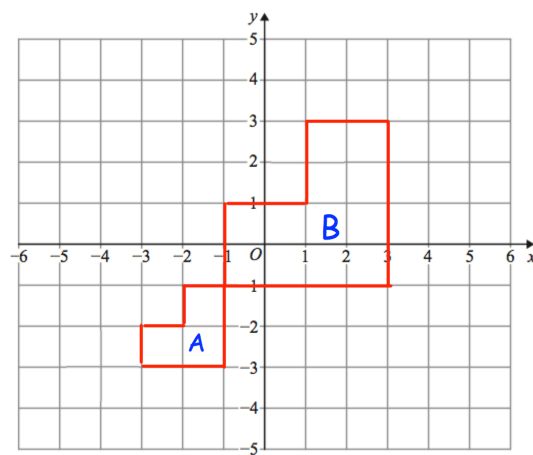
(a)



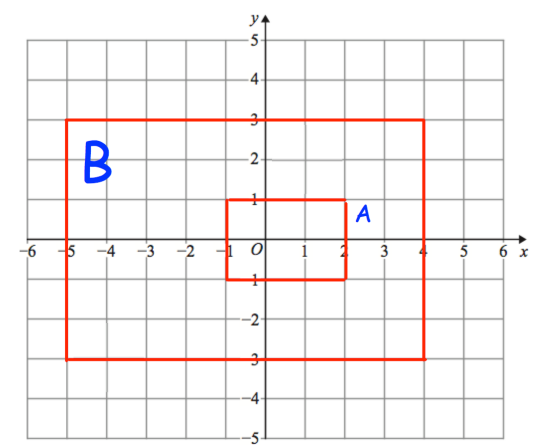
(b)



(c)

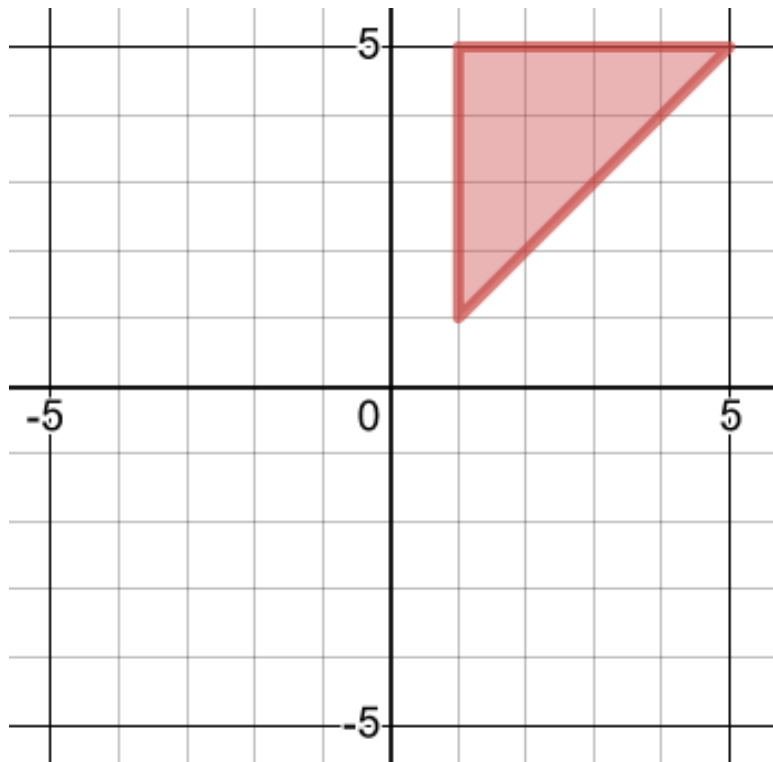


(d)



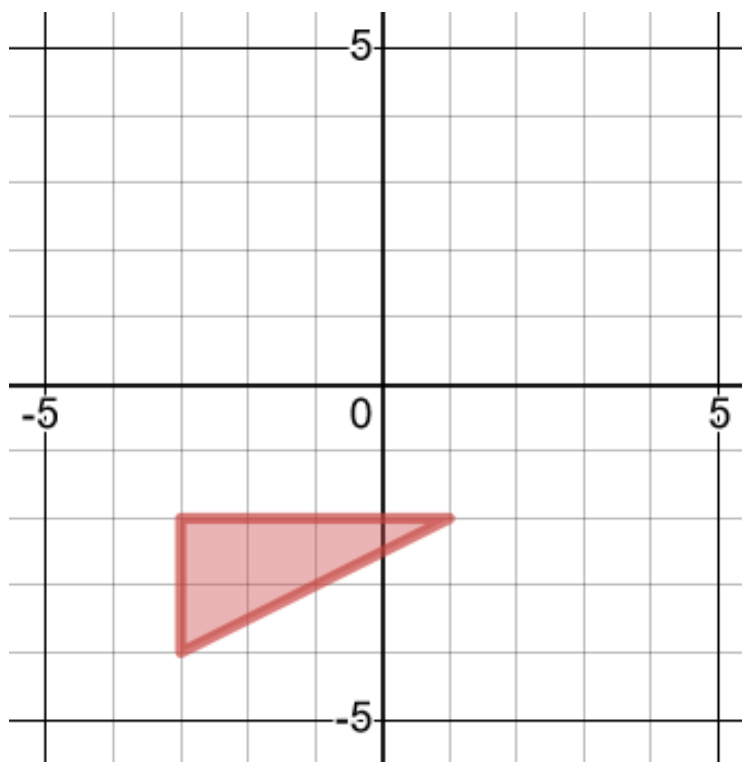
Worked Example

Enlarge about $(-3, -3)$, scale factor $\frac{1}{2}$



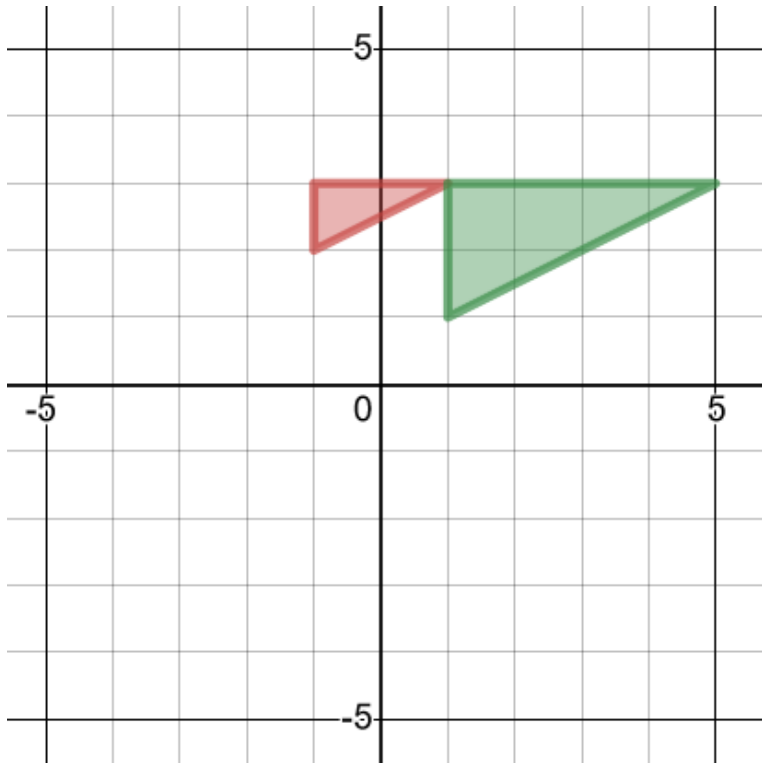
Your Turn

Enlarge about $(-1, 0)$, scale factor $\frac{1}{2}$



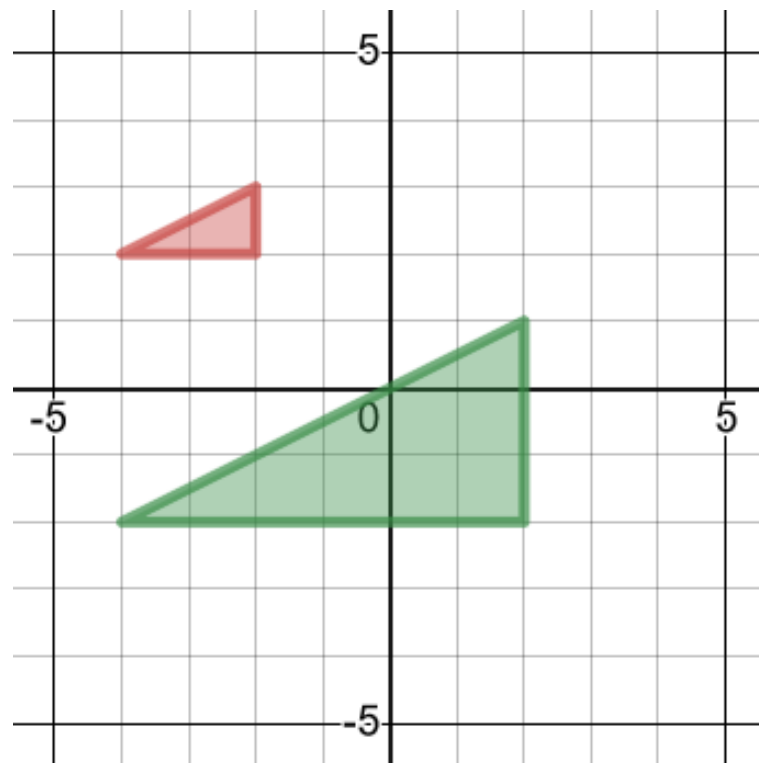
Worked Example

Describe the single transformation of the green object onto the red image



Your Turn

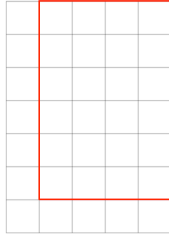
Describe the single transformation of the green object onto the red image



Fluency Practice

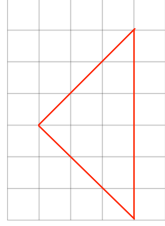
Question 1: Copy these shapes and then enlarge by the scale factor given.

(a)



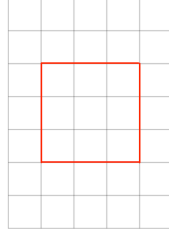
Enlarge by scale factor $\frac{1}{2}$

(b)



Enlarge by scale factor $\frac{1}{3}$

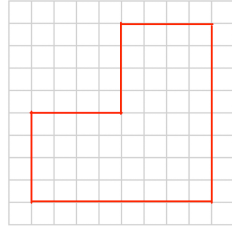
(c)



Enlarge by scale factor $\frac{2}{3}$

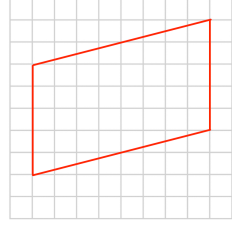
Question 2: Copy these shapes and then enlarge by the scale factor given.

(a)



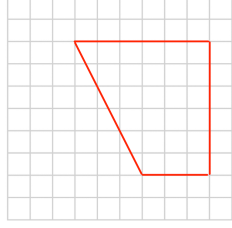
Enlarge by scale factor $\frac{1}{4}$

(b)



Enlarge by scale factor $\frac{1}{2}$

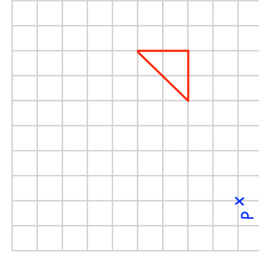
(c)



Enlarge by scale factor $1\frac{1}{3}$

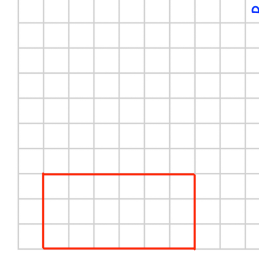
Question 3: Enlarge each shape by the scale factor given
Use P as the centre of enlargement.

(a)



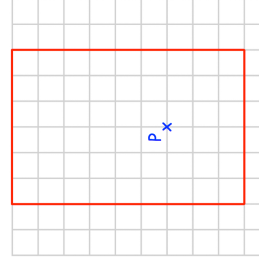
Enlarge by scale factor $\frac{1}{2}$

(b)



Enlarge by scale factor $\frac{1}{3}$

(c)

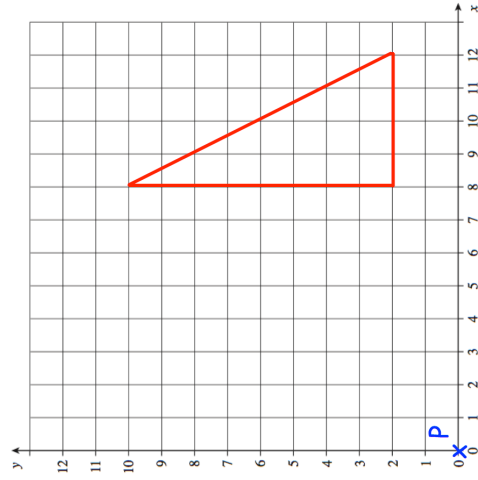


Enlarge by scale factor $\frac{2}{3}$

Fluency Practice

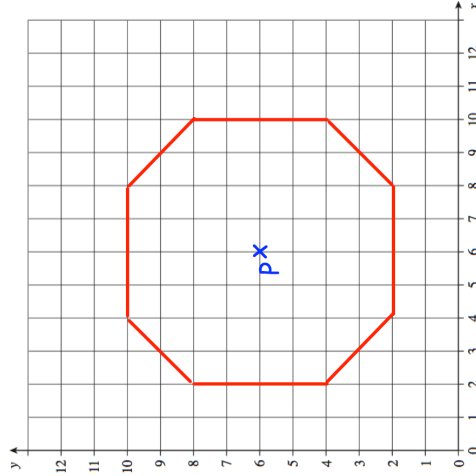
Question 4: Enlarge each shape by the scale factor given
Use P as the centre of enlargement.

(a)



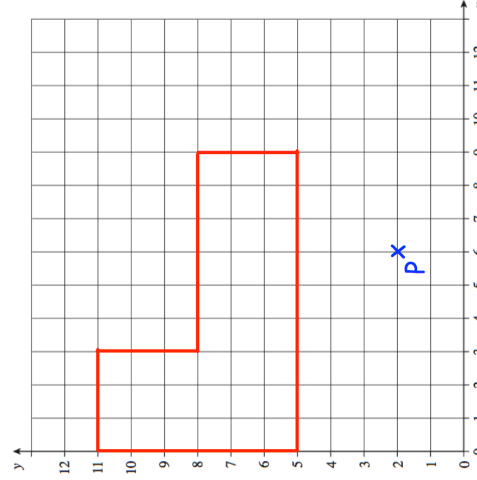
Enlarge by scale factor $\frac{1}{4}$

(b)



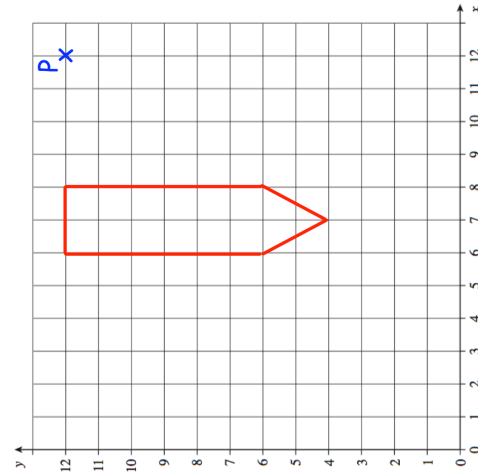
Enlarge by scale factor $1\frac{1}{2}$

(c)



Enlarge by scale factor $2\frac{2}{3}$

(d)

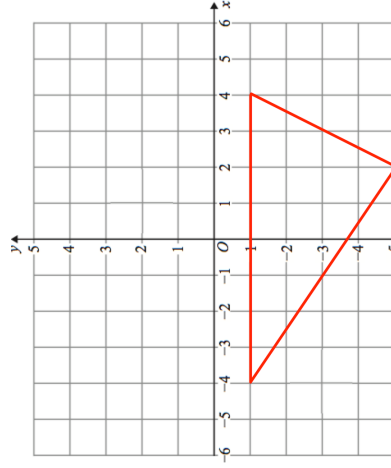


Enlarge by scale factor $1\frac{1}{2}$

Fluency Practice

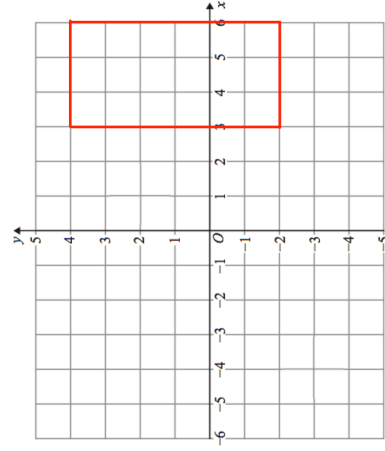
Question 5: Enlarge each shape by the scale factor given
The coordinates for each centre of enlargement are given.

(a)



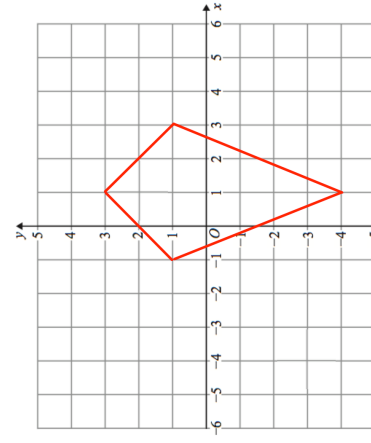
Enlarge by scale factor $\frac{1}{2}$ using
(0, 1) as the centre of enlargement

(b)



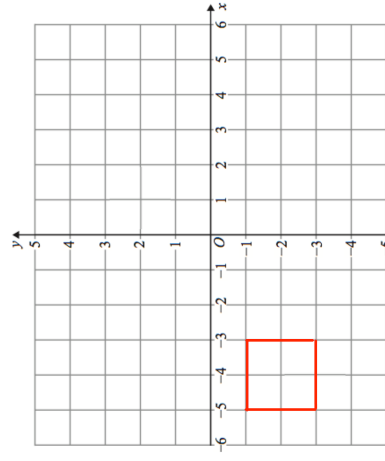
Enlarge by scale factor $\frac{1}{3}$ using
(-3, 1) as the centre of enlargement

(c)



Enlarge by scale factor $\frac{1}{2}$ using
(-5, -5) as the centre of enlargement

(d)

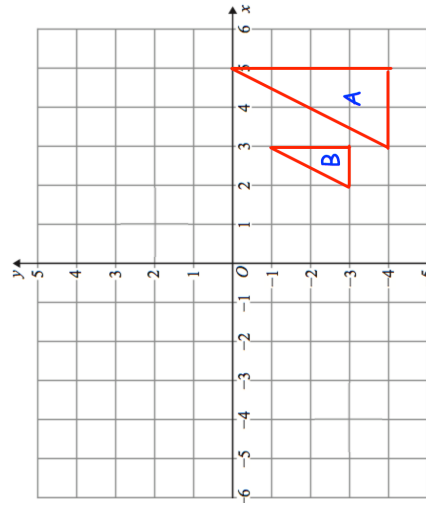


Enlarge by scale factor $2\frac{1}{2}$ using
(-5, -3) as the centre of enlargement

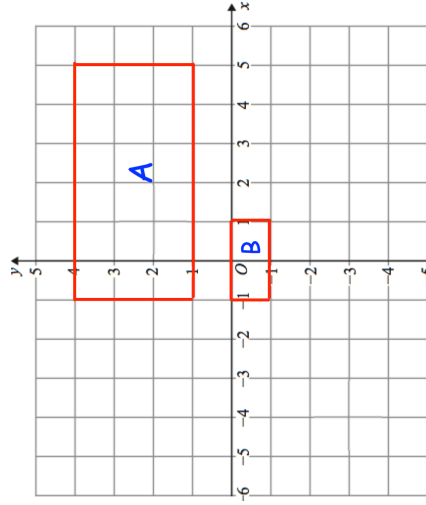
Fluency Practice

Question 6: Describe fully the single transformation that takes shape A to shape B.

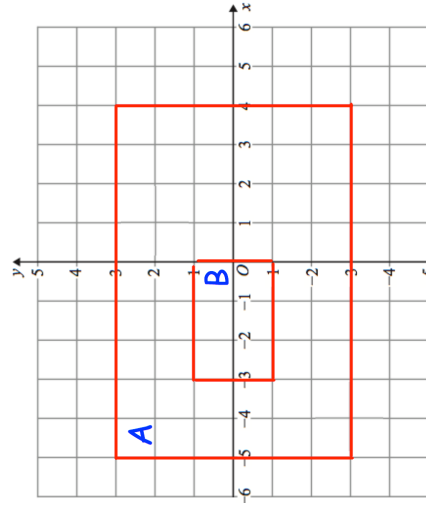
(a)



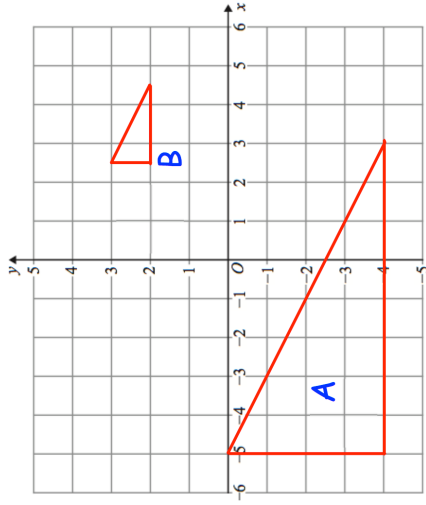
(b)



(c)

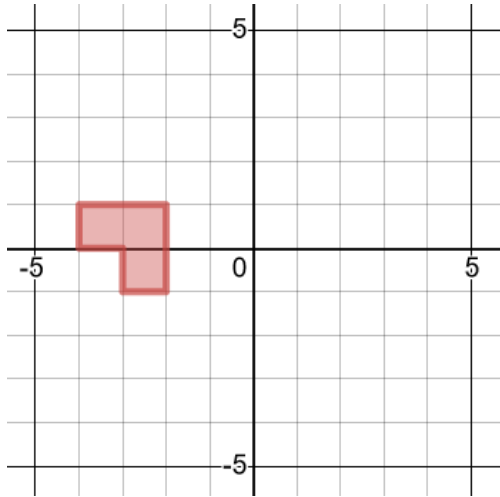


(d)

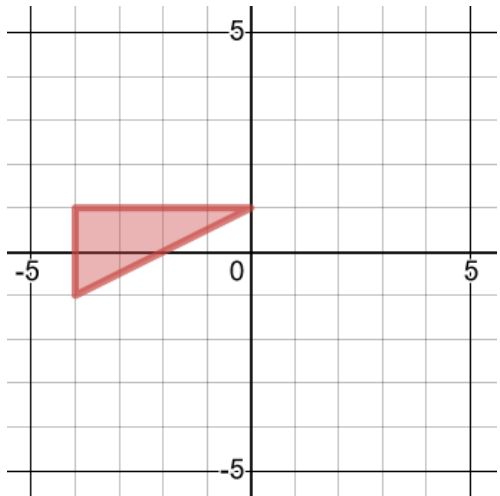


Worked Example

Enlarge about $(-2, 1)$, scale factor -2

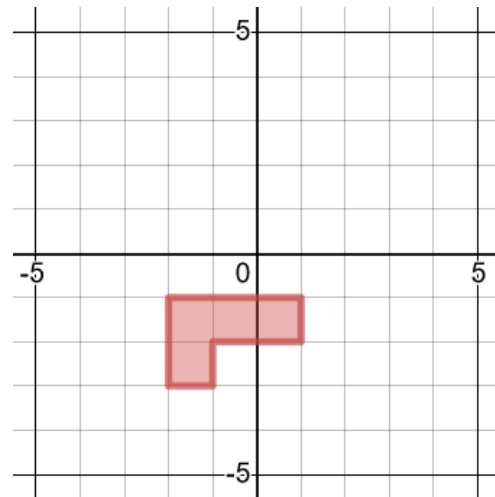


Enlarge about $(-2, -3)$, scale factor $-\frac{1}{2}$

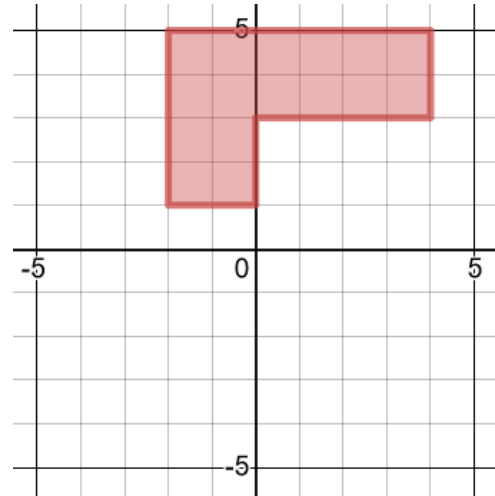


Your Turn

Enlarge about $(0, -1)$, scale factor -2

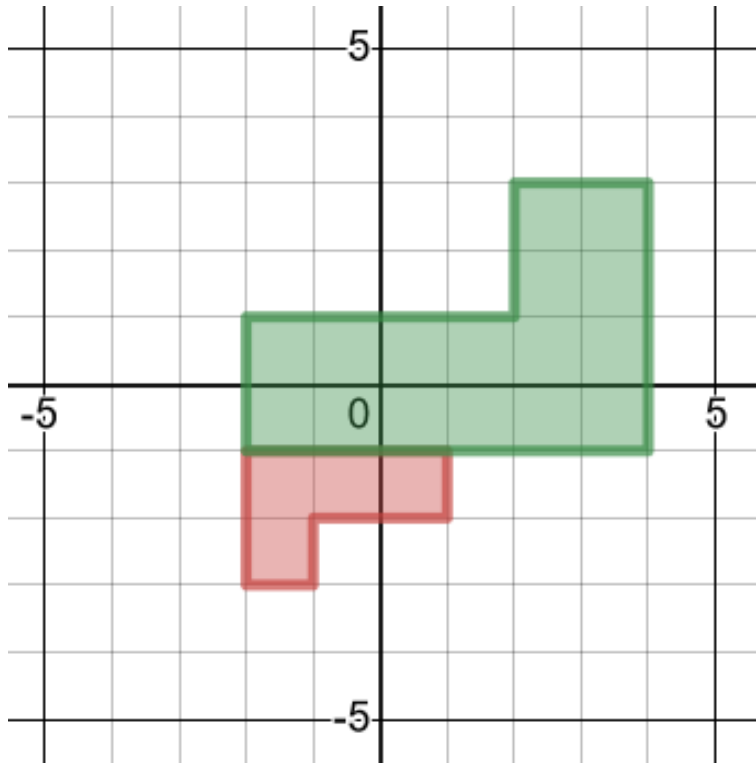


Enlarge about $(2, -1)$, scale factor $-\frac{1}{2}$



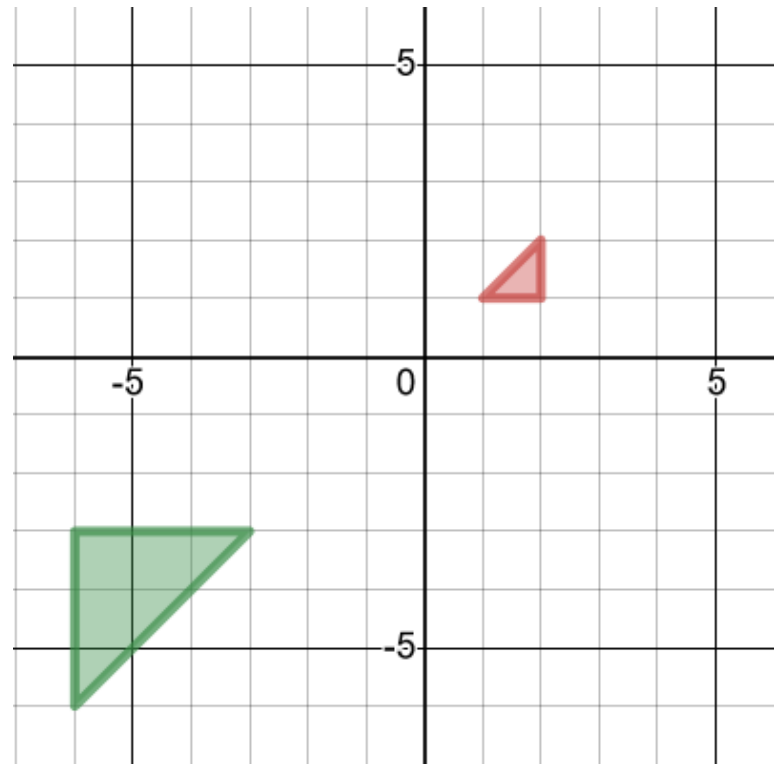
Worked Example

Describe the single transformation of the red object onto the green image



Your Turn

Describe the single transformation of the red object onto the green image



Fluency Practice

Question 1: Enlarge each shape by the scale factor given
Use P as the centre of enlargement.

(a)

Enlarge by scale factor -3

(b)

Enlarge by scale factor -2

(c)

Enlarge by scale factor -4

(d)

Enlarge by scale factor -2

(e)

Enlarge by scale factor -2

(f)

Enlarge by scale factor -½

Question 2: Enlarge each shape by the scale factor given
Use P as the centre of enlargement.

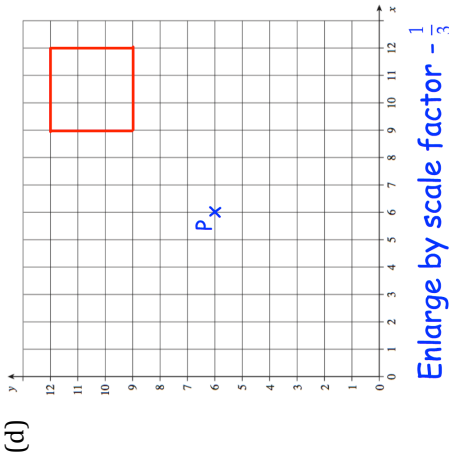
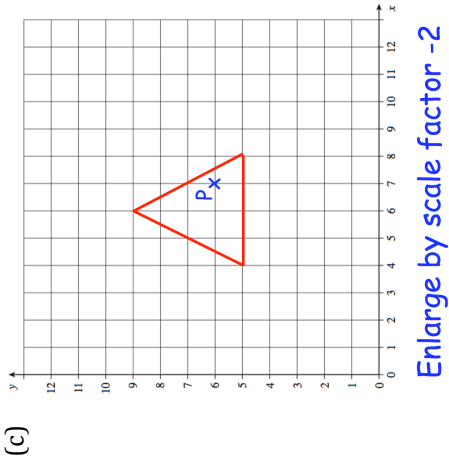
(a)

Enlarge by scale factor -3

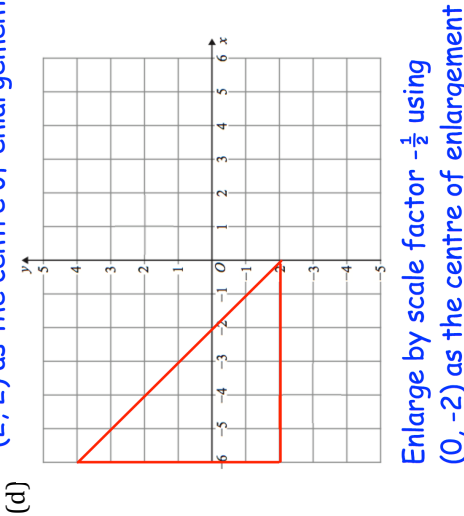
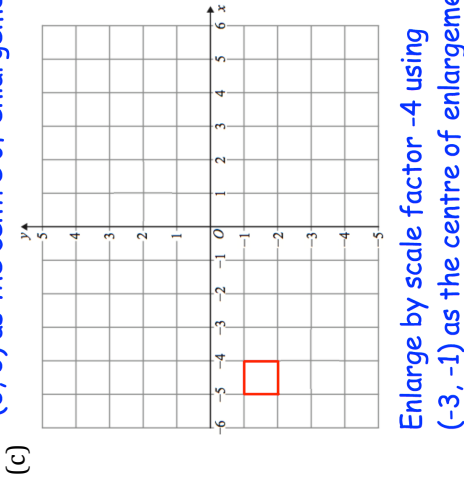
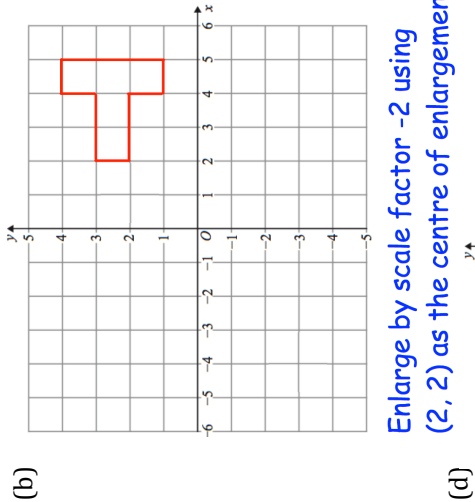
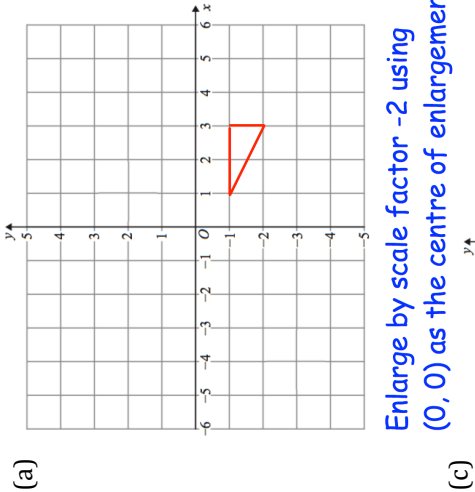
(b)

Enlarge by scale factor -4

Fluency Practice



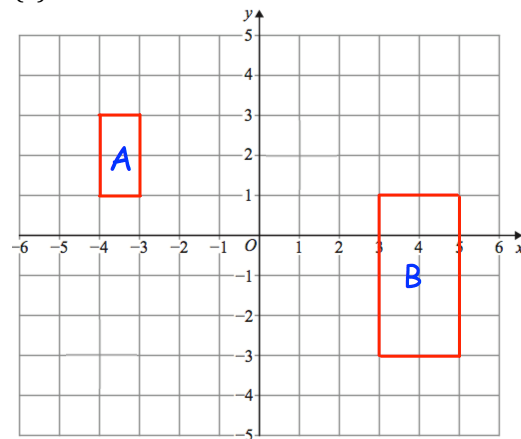
Question 3: Enlarge each shape by the scale factor given
The coordinates for each centre of enlargement are given.



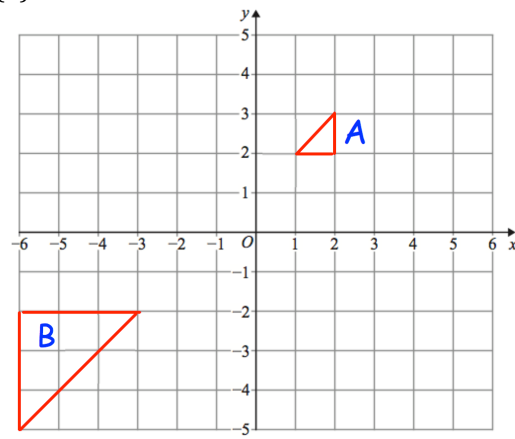
Fluency Practice

Question 4: Describe fully the single transformation that takes shape A to shape B.

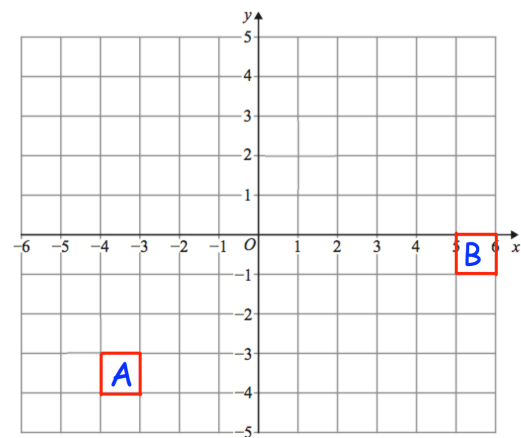
(a)



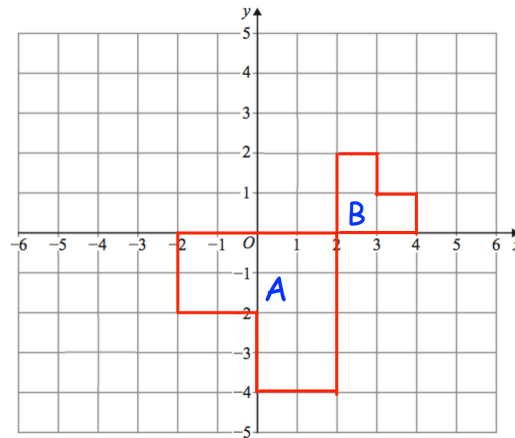
(b)



(c)



(d)

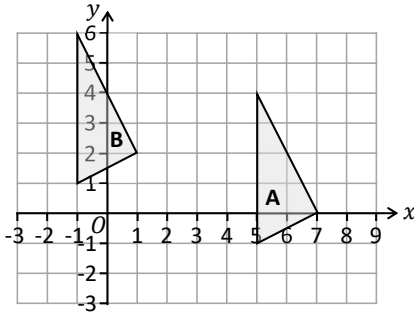


Mixed Transformations

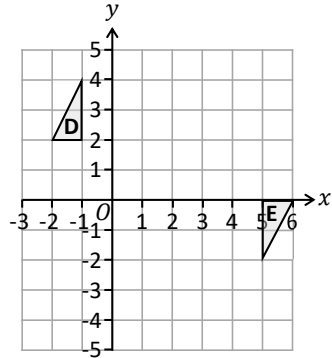
Fluency Practice

1. Describe the single transformation that maps shape A onto shape B.

Translate triangle B by the vector $\begin{pmatrix} 3 \\ -4 \end{pmatrix}$
Label the new triangle C.

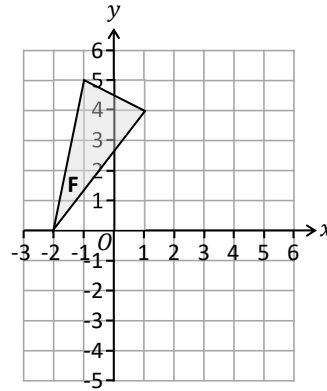


2. Describe the **2 reflections** that map shape D onto shape E.

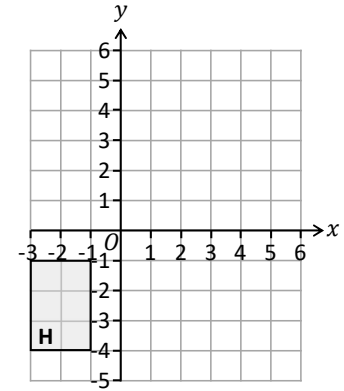


Transformations

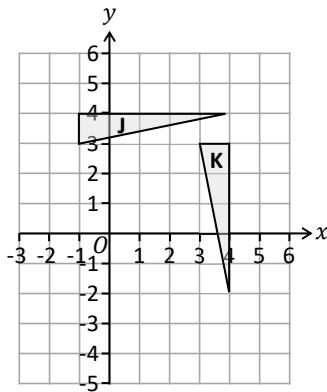
3. Reflect triangle F
in the line $y = x$
Label the new triangle G.



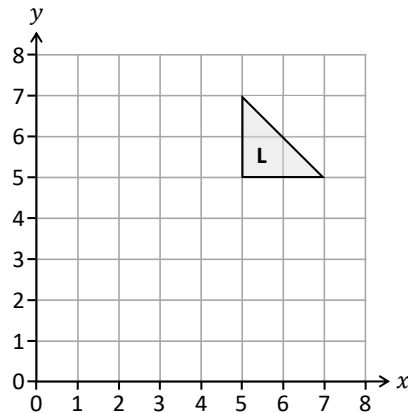
4. Rotate shape H
90° clockwise about (3, -3).
Label the new shape I.



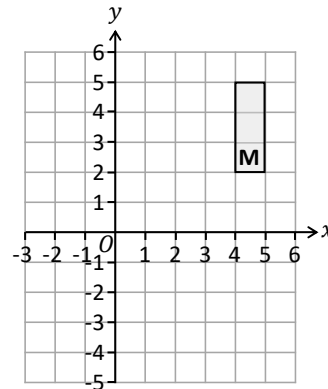
5. Describe the single transformation that maps shape J onto shape K.



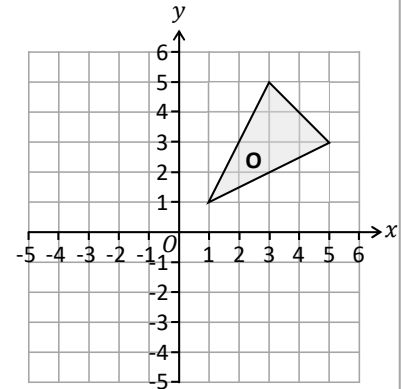
6. Use the centre of enlargement (7, 7) to
enlarge shape L by a scale factor of 3.
& then enlarge shape L by a scale factor of $\frac{1}{2}$.



7. Enlarge shape M by
scale factor -2 with (3, 2) as
the centre of enlargement.
Label the new shape N.



8. Enlarge triangle O by scale factor $-\frac{1}{2}$
with centre of enlargement (-1, 3).
Label the triangle P.

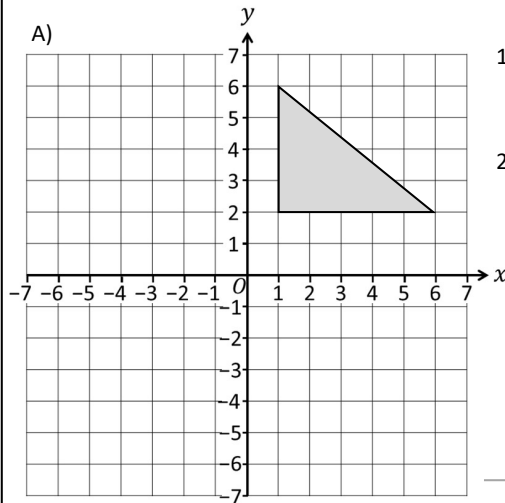


Combined Transformations

Fluency Practice

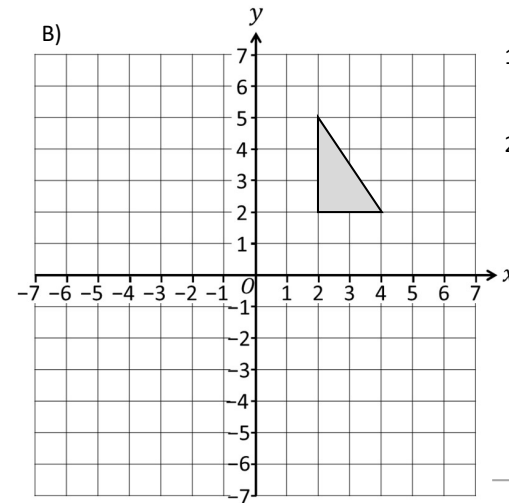
1

Combining Transformations



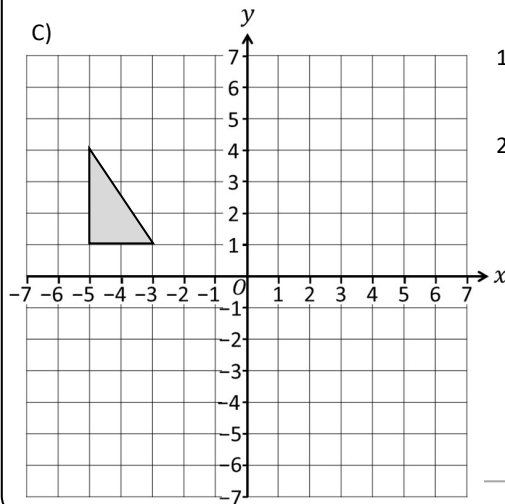
- 1) Translate by the vector $\begin{pmatrix} -7 \\ -4 \end{pmatrix}$
- 2) Translate by the vector $\begin{pmatrix} 8 \\ -4 \end{pmatrix}$

Describe as a single transformation:



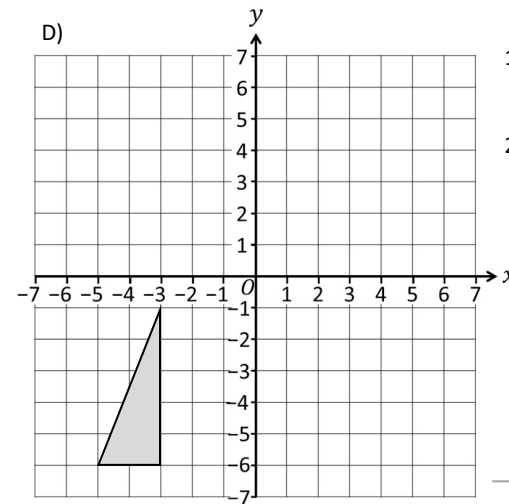
- 1) Rotate 90° clockwise about the origin.
- 2) Translate by the vector $\begin{pmatrix} 0 \\ 4 \end{pmatrix}$

Describe as a single transformation:



- 1) Rotate 180° about the origin.
- 2) Reflect in the line $y = 0$

Describe as a single transformation:



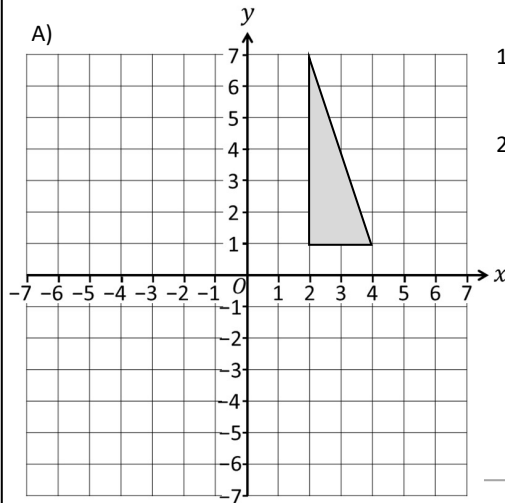
- 1) Reflect in the line $x = -1$
- 2) Reflect in the line $y = -1$

Describe as a single transformation:

Fluency Practice

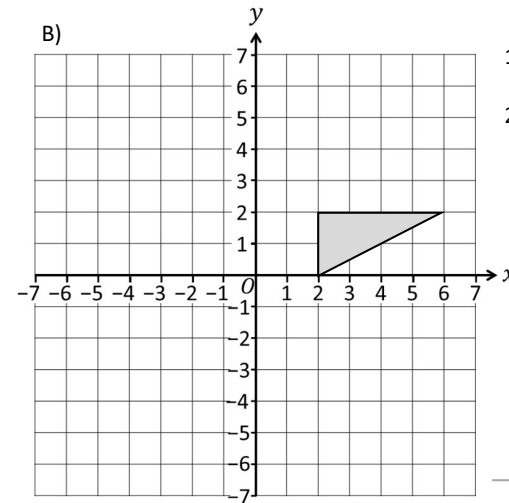
2

Combining Transformations



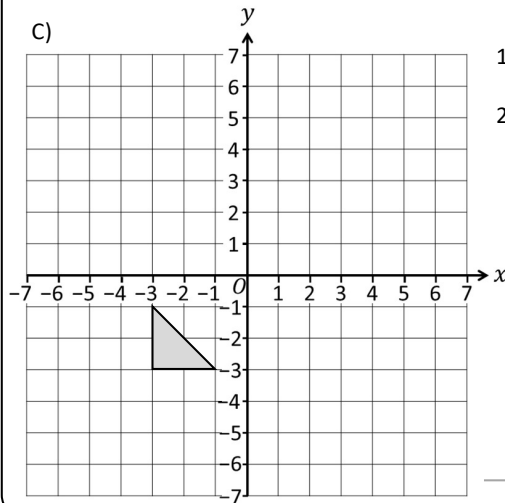
- 1) Rotate 180° about $(1, 0)$.
- 2) Translate by the vector $\begin{pmatrix} -2 \\ 4 \end{pmatrix}$

Describe as a single transformation:



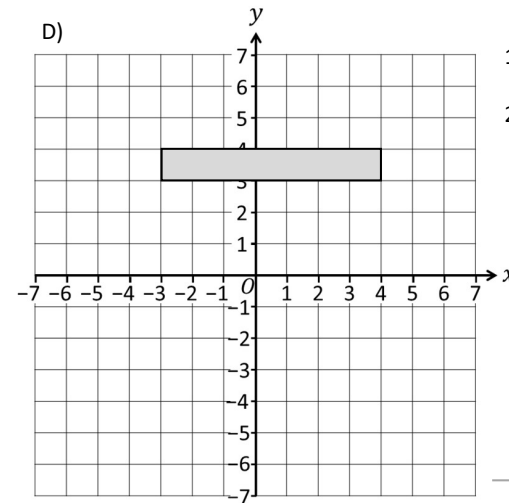
- 1) Reflect in the line $y = x$
- 2) Reflect in the line $x = -1$

Describe as a single transformation:



- 1) Reflect in the line $y = -x$
- 2) Reflect in the line $x = -1$

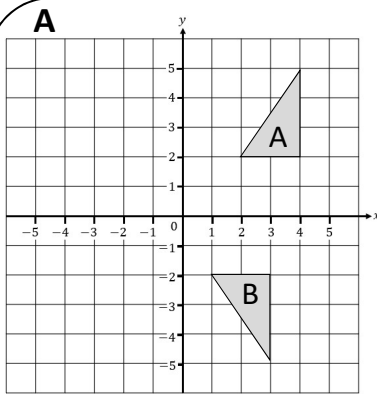
Describe as a single transformation:



- 1) Reflect in the line $y = x$
- 2) Rotate 180° about the origin.

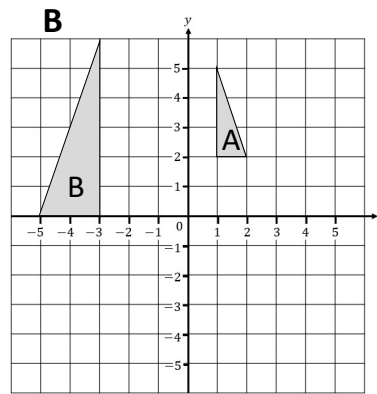
Describe as a single transformation:

Fluency Practice



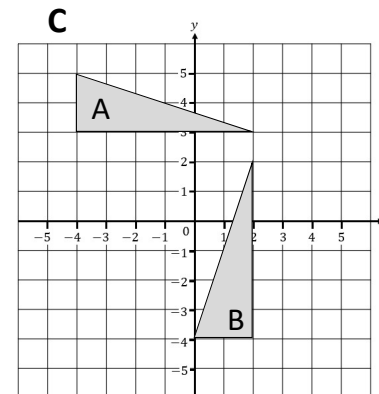
T1)

T2)



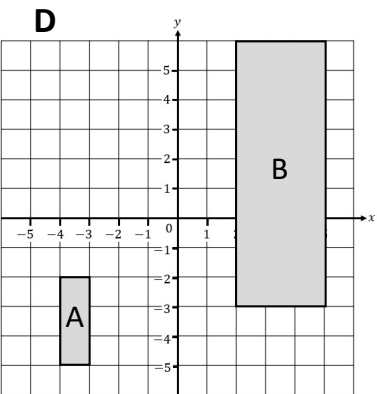
T1)

T2)



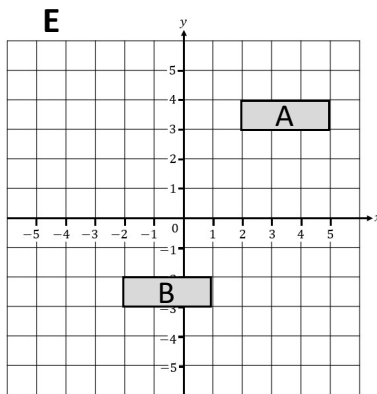
T1)

T2)



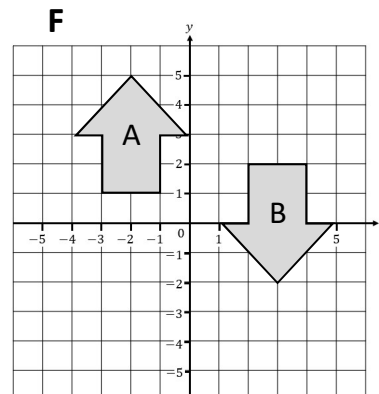
T1)

T2)



T1)

T2)



T1)

T2)

How is each shape transformed from A to B?

Pick **only** from those below.

Reflected in $y = 0$

Translation $\begin{pmatrix} 1 \\ 3 \end{pmatrix}$

Reflected in $x = 0$

Enlarged, SF = 2, (1, 4)

Rotated 180° clockwise around (0,0)

Rotated 90° anticlockwise around (2,3)

Enlarged, SF = 3, (-5,-5)

Translation $\begin{pmatrix} -1 \\ 0 \end{pmatrix}$

Translation $\begin{pmatrix} 4 \\ 2 \end{pmatrix}$

Reflected in $y = 1$

Translation $\begin{pmatrix} -4 \\ -1 \end{pmatrix}$

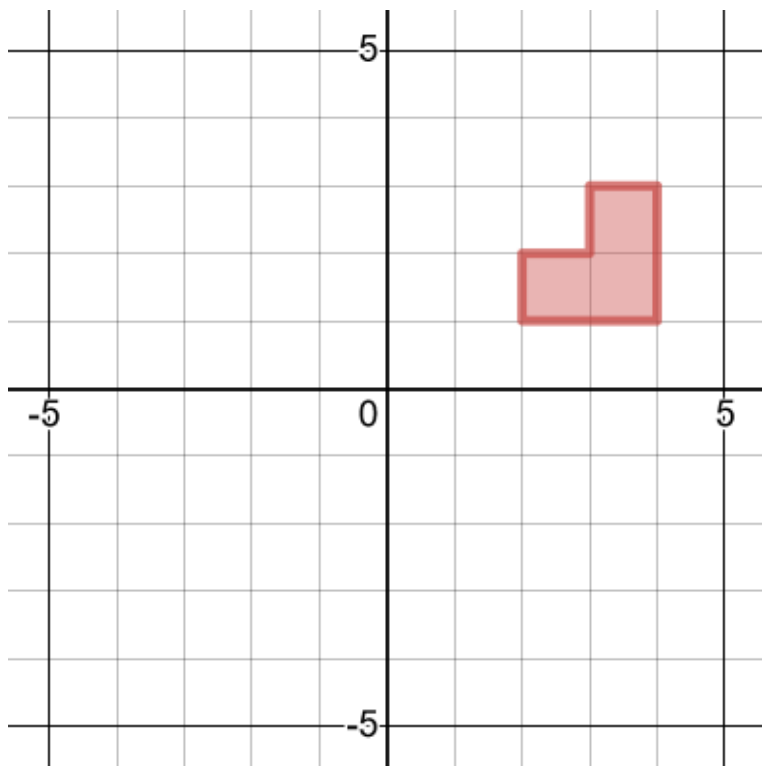
Translated $\begin{pmatrix} 0 \\ -1 \end{pmatrix}$

Extra Notes

5 Invariant Points

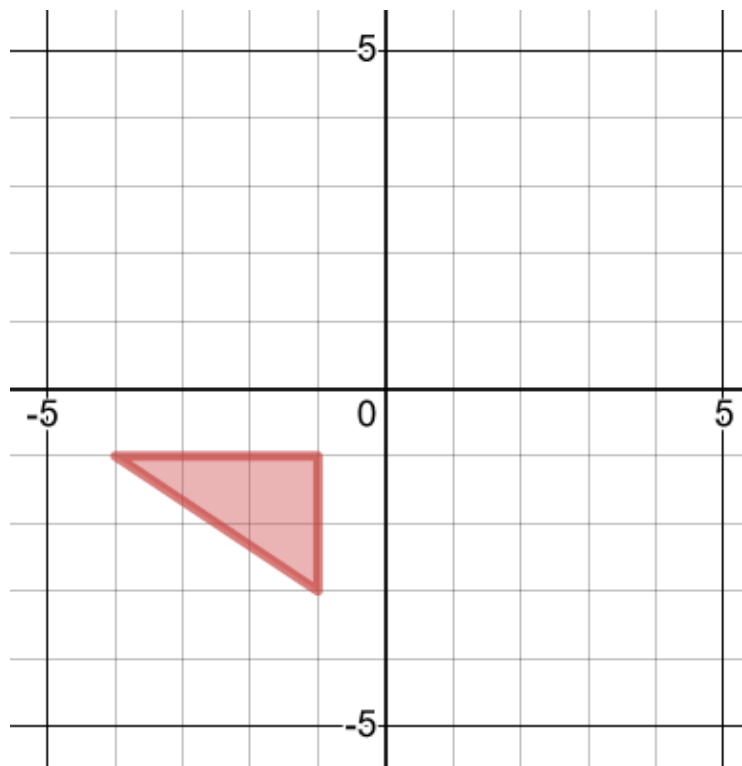
Worked Example

Reflect in the line $y = x$
Are there any invariant points?



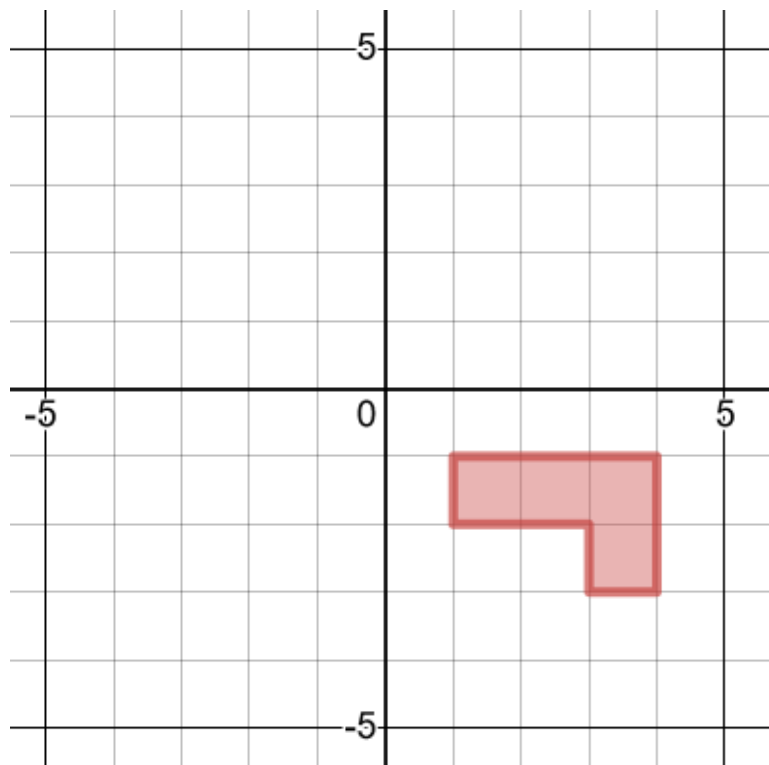
Your Turn

Reflect in the line $y = -1$
Are there any invariant points?



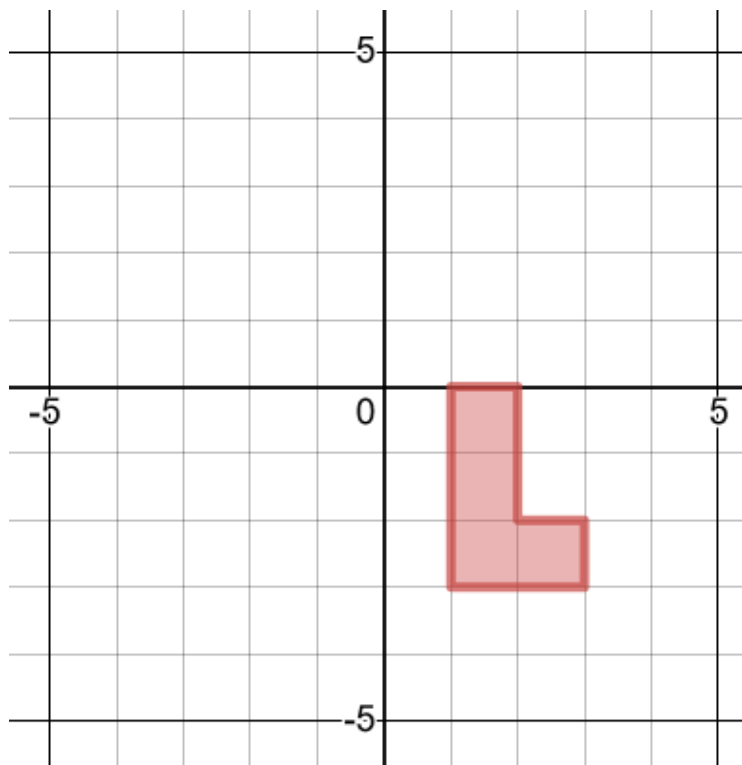
Worked Example

Rotate 180° about $(1, -1)$
Are there any invariant points?



Your Turn

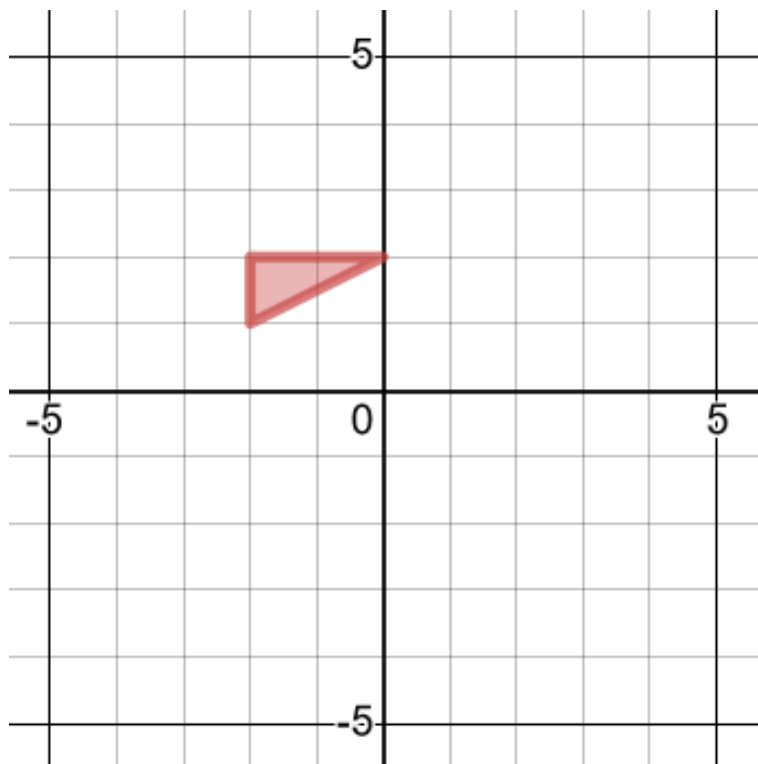
Rotate 180° about $(1, 0)$
Are there any invariant points?



Worked Example

Are there any invariant points?

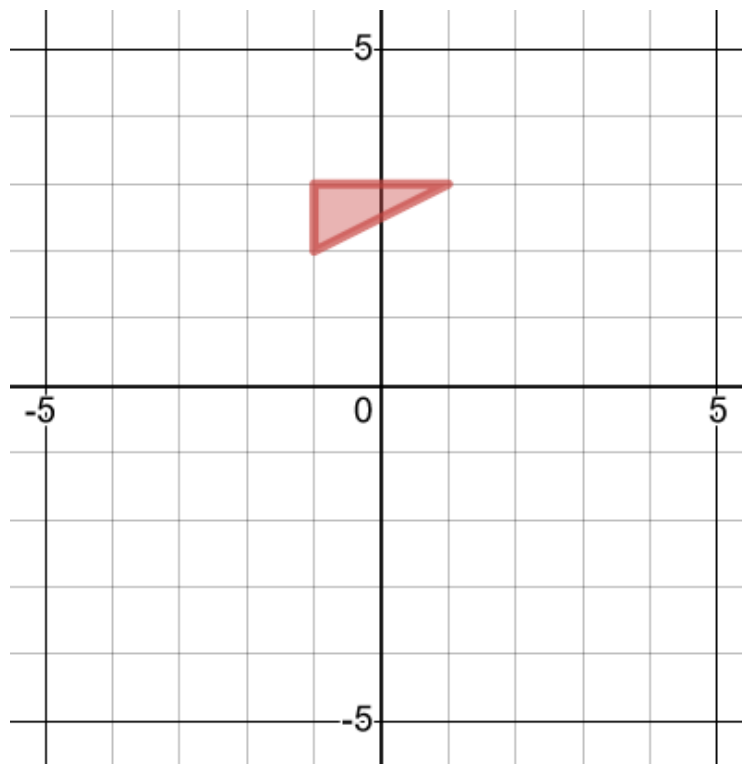
Enlarge about $(-2, 2)$, scale factor 2



Your Turn

Are there any invariant points?

Enlarge about $(-1, 2)$, scale factor 3

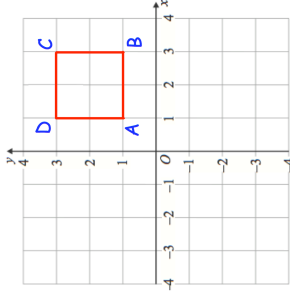


Fluency Practice

Question 1: ABCD is a square.

(a) Translate ABCD using vector $\begin{pmatrix} -3 \\ -1 \end{pmatrix}$

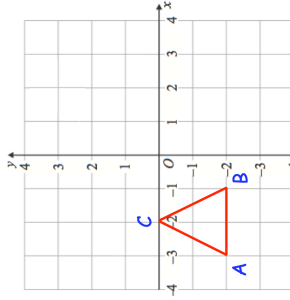
(b) Are there any invariant points?
If so, which point(s) are invariant?



Question 2: ABC is an isosceles triangle.

(a) Reflect ABC in the x-axis

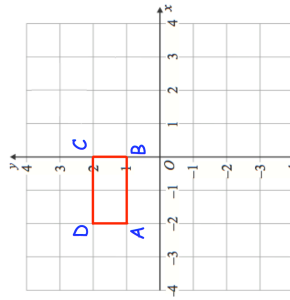
(b) Are there any invariant points?
If so, which point(s) are invariant?



Question 3: ABCD is a rectangle.

(a) Enlarge ABCD by scale factor 2, with centre of enlargement $(-2, 2)$

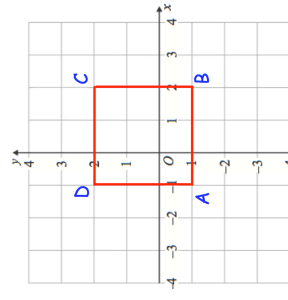
(b) Are there any invariant points?
If so, which point(s) are invariant?



Question 4: ABCD is a square

(a) Reflect ABCD in the line $y = x$

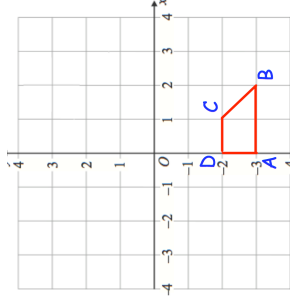
(b) Are there any invariant points?
If so, which point(s) are invariant?



Fluency Practice

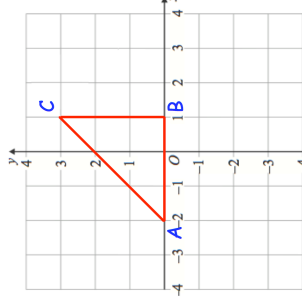
Question 5: ABCD is a trapezium

- Enlarge ABCD by scale factor -2 , with centre of enlargement $(1, -2)$
- Are there any invariant points?
If so, which point(s) are invariant?



Question 6: ABC is a triangle.

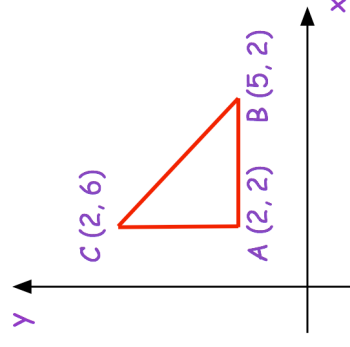
- Rotate ABC 90° clockwise about $(1, 0)$
- Are there any invariant points?
If so, which point(s) are invariant?



Question 7: A sketch of triangle ABC is shown

For each transformation below, write down the letter(s) of any vertices that are invariant.

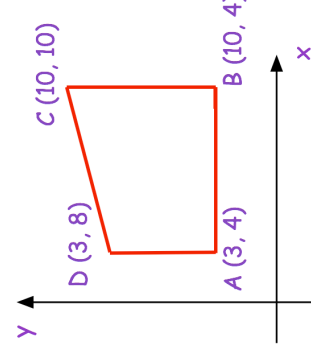
- Rotation 180° about the point A
- Enlargement by scale factor $\frac{1}{2}$ with centre $(2, 6)$
- Reflection in the line $x = 5$
- Reflection in the line $y = x$
- Reflection in the line $y = 2$



Question 8: A sketch of quadrilateral ABCD is shown.

For each transformation below, write down the letter(s) of any vertices that are invariant.

- Reflection in the line $y = 8$
- Enlargement by scale factor -4 with centre A
- Reflection in the line $x = 3$
- Reflection in the line $y = x$



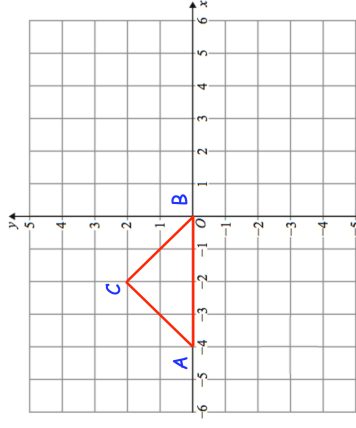
Purposeful Practice

Apply

Question 1: ABC is a triangle.

Describe fully a **single** transformation of ABC so that:

- (a) None of the vertices are invariant.
- (b) Exactly one vertex is invariant.
- (c) Exactly two vertices are invariant.



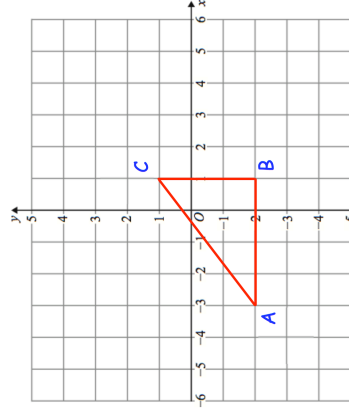
Question 2: Here is triangle ABC

Olivia says “if ABC is reflected in the line $x = -3$ there is one invariant point.”

Amelia says “if ABC is reflected in the line $y = -2$ there are two invariant points.”

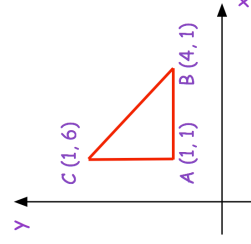
Isla says “if ABC is reflected in the line $x = 1$ there are two vertices that are invariant.”

Which student is incorrect? Explain your answer.



Question 3: Here is a sketch of triangle ABC.

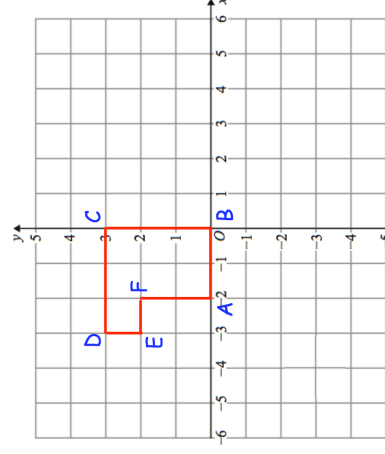
Describe fully a **single** transformation of ABC so that all the points on AC are invariant and the point B is not invariant.



Question 4: Here is shape ABCDEF

Describe fully **single** transformations so that from the six vertices:

- (a) only vertices B and C are invariant.
- (b) only vertex F is invariant.
- (c) only vertices B, D and F are invariant.

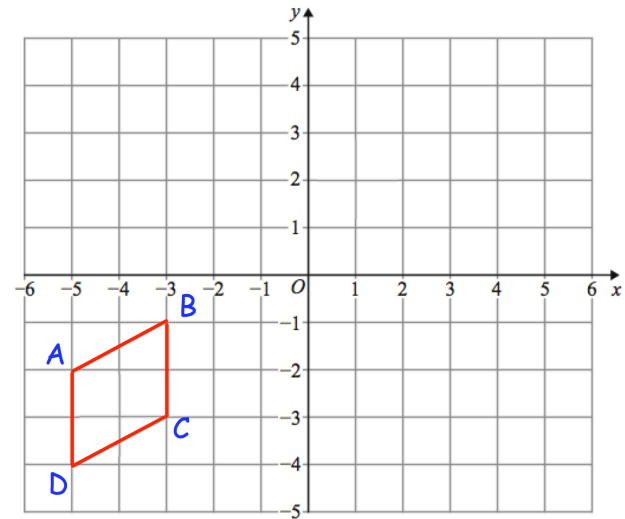


Purposeful Practice

Question 5: Here is quadrilateral ABCD

ABCD is reflected in the line $x = -1$
followed by a reflection in the line $y = -x$
followed by a rotation of 180° about $(-1, -1)$

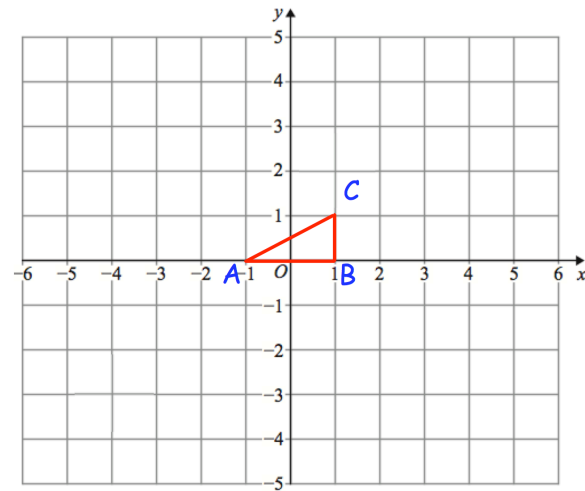
Which of the vertices are invariant?



Question 6: Shown is triangle ABC

ABC is rotated 180° about $(-1, 2)$ and then
translated by the vector $\begin{pmatrix} 2 \\ -4 \end{pmatrix}$

Write down the coordinate of the invariant point.



Extra Notes