KING EDWARD VI
HANDSWORTH GRAMMAR
SCHOOL FOR BOYS

KING EDWARD VI
ACADEMY TRUST
BIRMINGHAM

Year 10

2024 Mathematics 2025

Unit 16 Tasks – Part 1

DO NOT WRITE INSIDE

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Unit 16 Tasks – Part 2

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Contents

1 Recurring Decimals

Intelligent Practice

Write the following out fully:

1) $0.\dot{5}$

2) $0.4\dot{5}$

3) $0.\dot{4}\dot{5}$

4) $0.3\dot{4}\dot{5}$

5) $0.\dot{3}4\dot{5}$

6) $0.2\dot{3}4\dot{5}$

7) $0.\dot{2}34\dot{5}$

8) $1.\dot{2}34\dot{5}$

Write the following using dot notation:

1) $0.666\ldots$

2) $0.7666\ldots$

3) $0.767676\ldots$

4) $0.8767676\ldots$

5) $0.876876876\ldots$

6) $0.9876876876\ldots$

7) $0.987698769876\ldots$

8) $10.987698769876\ldots$

Purposeful Practice

changing a fraction into a decimal

(1) work out what these fractions are as decimals by division (without using a calculator)

(a) $\frac{2}{5}$ (b) $\frac{3}{8}$ (c) $\frac{7}{8}$ (d) $\frac{4}{5}$ (e) $\frac{3}{25}$ (f) $\frac{7}{20}$ (g) $\frac{3}{80}$

why do you think these fractions as decimals terminate?

(2) work out what these fractions are as decimals by division (without using a calculator)

(a) $\frac{1}{6}$ (b) $\frac{5}{6}$ (c) $\frac{1}{9}$ (d) $\frac{2}{9}$ (e) $\frac{1}{11}$ (f) $\frac{2}{11}$ (g) $\frac{1}{22}$

(3) work out what these fractions are as decimals by division (without using a calculator)

(a) $\frac{1}{7}$ (b) $\frac{2}{7}$ (c) $\frac{3}{7}$ (d) $\frac{4}{7}$ (e) $\frac{5}{7}$ (f) $\frac{6}{7}$

2 × 7 = 14	6 × 7 = 42
3 × 7 = 21	7 × 7 = 49
4 × 7 = 28	8 × 7 = 56
5 × 7 = 35	9 × 7 = 63

what patterns can you find in the recurring decimal values of sevenths?

Purposeful Practice

changing a fraction into a decimal

(1) work out what these fractions are as decimals by division (without using a calculator)

(a) $\frac{1}{25}$ (b) $\frac{1}{40}$ (c) $\frac{1}{80}$ (d) $\frac{1}{16}$ (e) $\frac{1}{32}$

why do you think these fractions as decimals terminate?

(2) work out what these fractions are as decimals by division (without using a calculator)

(a) $\frac{1}{13}$ (b) $\frac{2}{13}$ (c) $\frac{3}{13}$ (d) $\frac{4}{13}$ (e) $\frac{5}{13}$

$2 \times 13 = 26$
$3 \times 13 = 39$
$4 \times 13 = 52$
$5 \times 13 = 65$
$6 \times 13 = 78$
$7 \times 13 = 91$
$8 \times 13 = 104$
$9 \times 13 = 117$

(3) work out which fraction is bigger (with a calculator)

(a) $\frac{5}{9}$ or $\frac{6}{11}$

(b) $\frac{7}{8}$ or $\frac{17}{20}$

(c) $\frac{2}{11}$ or $\frac{3}{17}$

(d) $\frac{4}{17}$ or $\frac{15}{62}$

(4) without a calculator

$\frac{27}{40} = 0.675$

$\frac{29}{40} = 0.725$

what are:

(a) $\frac{31}{40}$ (b) $\frac{37}{40}$

(5) without a calculator

$\frac{29}{32} = 0.90625$

what are:

(a) $\frac{29}{320}$ (b) $\frac{290}{32}$

(c) $\frac{13}{32}$ (d) $\frac{21}{32}$

Fluency Practice

Ordering Recurring Decimals

A

0.678	0 •	6						
$0.6\dot{7}$	0 •	6						

____ < ____

B

0.252	0 •							
$0.\dot{2}$	0 •							

____ < ____

C

$0.\dot{5}\dot{6}$	0 •	5	6	5				
0.566	0 •							

____ < ____

D

$0.\dot{7}\dot{8}$	0 •				8			
$0.7\dot{8}$	0 •							8

____ < ____

E

$0.\dot{1}0\dot{2}$	0 •	1	0	2	1			
$0.1\dot{2}$	0 •					2		

____ < ____

F

$0.\dot{5}$	0 •							
$0.\dot{5}\dot{6}$	0 •							
$0.\dot{5}6\dot{5}$	0 •	5	6	5	5			

____ < ____ < ____

G

$0.\dot{0}8\dot{1}$	•				0			
$0.0\dot{8}\dot{1}$	•	0	8					
$0.08\dot{1}$	•					1		

____ < ____ < ____

H

$0.13\dot{1}$	•							1
$0.\dot{1}3\dot{1}$	•				1			
$0.\dot{1}\dot{3}$	•					1		

____ < ____ < ____

I

$9.7\dot{9}\dot{8}$	•							
$9.\dot{7}9\dot{8}$	•							
$9.\dot{7}98\dot{7}$	•							

____ < ____ < ____

By writing the denominator as a product of its prime factors, decide if each of these fractions would convert to a terminating or recurring decimal.

(a) $\frac{1}{8}$ (b) $\frac{1}{25}$ (c) $\frac{1}{15}$

(d) $\frac{1}{14}$ (e) $\frac{1}{50}$ (f) $\frac{1}{16}$

(g) $\frac{1}{30}$ (h) $\frac{1}{12}$ (i) $\frac{1}{40}$

Write out the following recurring decimals to show the first 10 decimal places.

(a) $0.\dot{4}$ (b) $0.\dot{7}$

(c) $0.\dot{1}\dot{4}$ (d) $0.\dot{2}\dot{3}$

(e) $0.\dot{1}2\dot{3}$ (f) $0.\dot{4}6\dot{1}$

(g) $0.0\dot{5}$ (h) $0.1\dot{7}\dot{2}$

Use your calculator to convert the following fractions into terminating or recurring decimals.

(a) $\frac{4}{9}$ (b) $\frac{2}{5}$ (c) $\frac{3}{10}$

(d) $\frac{7}{11}$ (e) $\frac{5}{16}$ (f) $\frac{1}{8}$

(g) $\frac{4}{7}$ (h) $\frac{29}{100}$ (i) $\frac{3}{35}$

Use your calculator to convert the following fractions into recurring decimals.

(a) $\frac{1}{9}$ (b) $\frac{2}{9}$ (c) $\frac{3}{9}$

Can you spot a pattern?

Use your calculator to convert the following fractions into recurring decimals.

(a) $\frac{12}{99}$ (b) $\frac{13}{99}$ (c) $\frac{14}{99}$

Can you spot a pattern?

Fluency Practice

For each of the following values of x, find

a) $10x$
b) $100x$
c) $1000x$
d) $2x$
e) $20x$

1) $x = 0.\dot{1}$
2) $x = 0.0\dot{1}$
3) $x = 0.00\dot{1}$
4) $x = 0.\dot{2}$
5) $x = 0.\dot{3}$
6) $x = 0.\dot{2}\dot{5}$
7) $x = 0.\dot{7}\dot{2}$
8) $x = 0.0\dot{2}\dot{5}$
9) $x = 0.1\dot{2}\dot{5}$
10) $x = 1.34\dot{2}\dot{4}$
11) $x = 0.\dot{2}2\dot{4}$
12) $x = 0.0\dot{2}2\dot{4}$
13) $x = 0.2\dot{2}2\dot{4}$
14) $x = 1.01\dot{1}0\dot{1}$

Given that $0.333... = \frac{1}{3}$

Write these as fractions:

a) 1.333…

b) 0.4333…

c) 0.35333…

d) 3.333…

Given that $\frac{5}{17} = 0.\dot{2}941176470588235\dot{}$, **write down** the following fractions as recurring decimals.

a) $\frac{12}{17}$

b) $\frac{1}{34}$

c) $\frac{27}{34}$

Which if the following fractions is equivalent to a recurring decimal?

(a) $\frac{7}{10}$ (b) $\frac{7}{9}$ (c) $\frac{7}{100}$

(d) $\frac{7}{11}$ (e) $\frac{7}{20}$ (f) $\frac{7}{30}$

Using an algebraic method, write the following recurring decimals as a fraction.

(a) $0.\dot{4}$ (b) $0.\dot{8}$

(c) $0.\dot{1}\dot{3}$ (d) $0.\dot{4}\dot{5}$

(e) $0.\dot{5}\dot{7}$ (f) $0.\dot{4}1\dot{2}$

(g) $0.\dot{1}2\dot{7}$ (h) $0.\dot{6}7\dot{5}$

Using an algebraic method, write the following recurring decimals as a fraction.

(a) $0.0\dot{4}$ (b) $0.0\dot{6}$

(c) $0.2\dot{3}$ (d) $0.1\dot{6}$

(e) $0.2\dot{1}\dot{7}$ (f) $0.00\dot{4}\dot{5}$

(g) $0.0\dot{1}5\dot{5}$ (h) $0.3\dot{6}9\dot{5}$

Use an algebraic method to show that:

(a) $0.\dot{1}\dot{5} = \frac{5}{33}$

(b) $0.\dot{1}4\dot{4} = \frac{16}{111}$

(c) $0.7\dot{1} = \frac{32}{45}$

Using an algebraic method, find $0.\dot{9}$ as a fraction.

Fluency Practice

A1 State the conditions under which a fraction can be written as a **terminating** decimal.	**A2** State the conditions under which a fraction can be written as a **recurring** decimal.	**A3** Which of the following can be written as **terminating** decimals: $\frac{2}{3}$ $\frac{3}{4}$ $\frac{4}{9}$ $\frac{5}{6}$ $\frac{5}{8}$ $\frac{3}{7}$ $\frac{3}{5}$	**A4** Which of the following can be written as **recurring** decimals: $\frac{5}{12}$ $\frac{7}{25}$ $\frac{3}{14}$ $\frac{5}{16}$ $\frac{5}{32}$ $\frac{5}{11}$
B1 Show that $0.\dot{5}=\frac{5}{9}$	**B2** Show that $0.7\dot{3}=\frac{11}{15}$	**B3** Show that $0.61\dot{6}=\frac{37}{60}$	**B4** Show that $3.5\dot{2}=3\frac{47}{90}$
C1 Show that $0.\dot{2}\dot{7}=\frac{3}{11}$	**C2** Show that $0.2\dot{5}\dot{7}=\frac{17}{66}$	**C3** Show that $0.\dot{4}4\dot{7}=\frac{149}{333}$	**C4** Show that $2.\dot{5}\dot{1}=2\frac{17}{33}$
D1 Work out $0.2\dot{7}\times 3$, writing your answer as a fraction in its simplest terms.	**D2** Work out $0.5\dot{7}-0.\dot{2}\dot{6}$, writing your answer as a fraction in its simplest terms.	**D3** x is a whole number such that $1\le x\le 9$ Write the recurring decimal $0.1\dot{x}$ as a fraction in its simplest terms.	**D4** y is a whole number such that $1\le y\le 9$ Show that $0.\dot{3}\dot{y}=\frac{y}{33}$

Problem Solving

These decimals have one digit recurring:

$$0.\dot{2} = 0.22222222 \ldots \qquad 0.07\dot{2} = 0.07222222 \ldots$$

1) Write three different decimals with one digit recurring.

2) Convert you decimals in part one into fractions in their simplest form. Use the algebraic method.

3) Find five fractions with different denominators when in simplest form that have one digit recurring.

4) Find the prime factors of the denominators. What do you notice?

5) Find five fractions with different denominators when in simplest form that have two digits recurring.

6) Find the prime factors of the denominators. What do you notice?

7) Repeat 5 and 6 for 3 digits recurring.

8) Investigate for other decimals with different number of digits recurring.

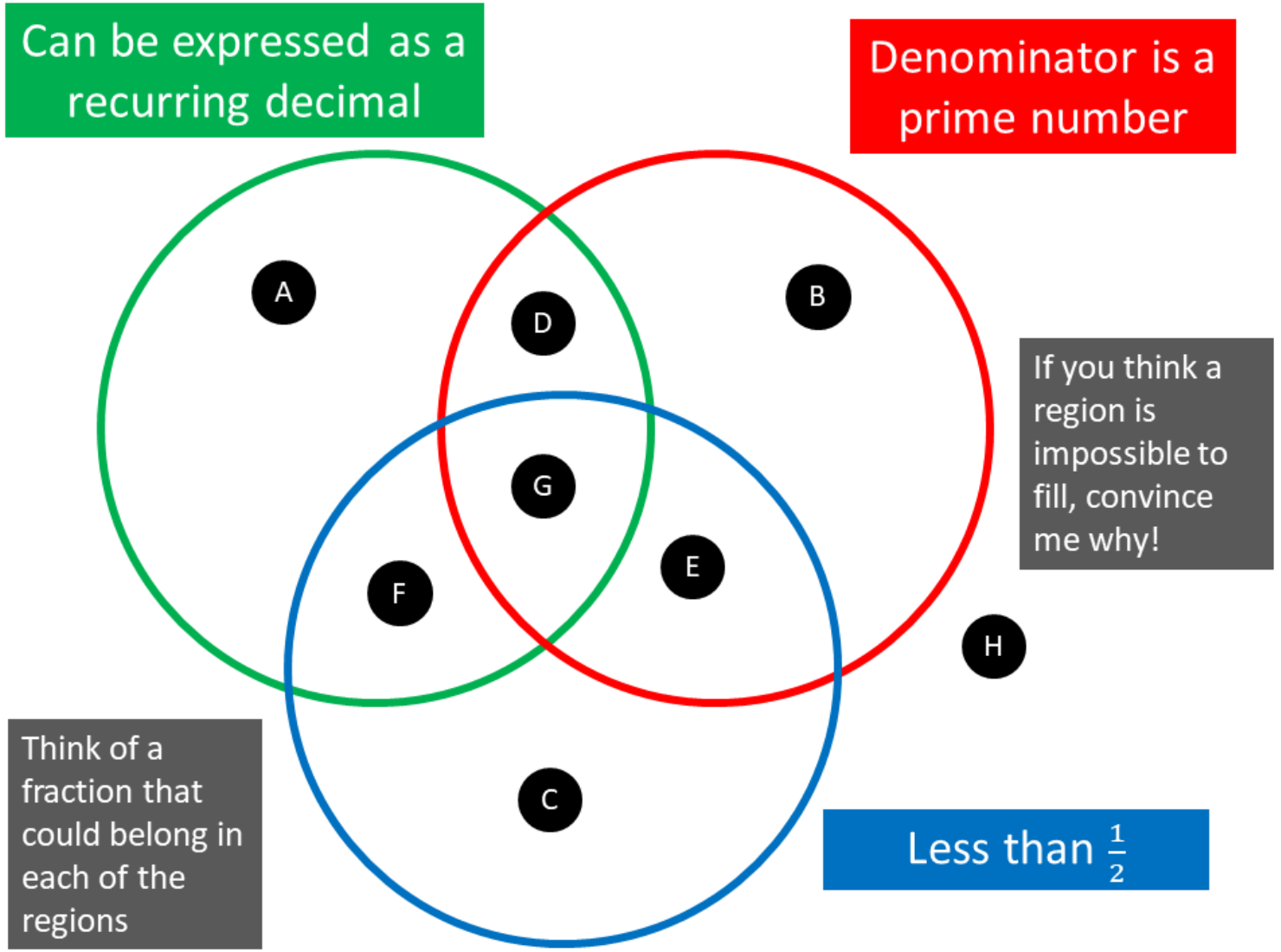
More-Same-Less

Instructions: Convert the decimal in the middle box to a fraction, giving your answer in its simplest form. Then fill in the remaining boxes, making the minimum change possible from the middle box.

Number of digits which recur when expressed as a decimal

Difference between numerator and denominator when expressed as a fraction in its simplest form	Less	Same	More
More			
Same		$0.\dot{3}\dot{6}$	
Less			

Maths Venns


Can be expressed as a recurring decimal
Denominator is a prime number
A
D
B
If you think a region is impossible to fill, convince me why!
G
E
F
H
Think of a fraction that could belong in each of the regions
C
Less than $\frac{1}{2}$

Prove each of the following sums using recurring decimals.

Prove that $0.\dot{1} \times 0.\dot{2}\dot{7} = \frac{1}{33}$

Prove that $0.\dot{5} \times 0.\dot{8}\dot{1} = \frac{5}{11}$

Prove that $0.\dot{1}\dot{8} \div 0.\dot{4} = \frac{9}{22}$

Prove that $0.\dot{8} \div 0.\dot{7}\dot{2} = 1\frac{2}{9}$

Prove that $0.1\dot{2}\dot{6} \div 0.\dot{2} = \frac{5}{8}$

Prove that $0.19\dot{4} \div 0.\dot{4} = \frac{7}{16}$

(a) Using algebra, show that

$$0.\dot{2} + 0.\dot{2}\dot{3} = \frac{5}{11}$$

(b) Using algebra, show that

$$1.3\dot{8}\dot{1} - 0.\dot{8}\dot{1} = \frac{31}{55}$$

(a) Using algebra, show that

$$0.\dot{5} \times 0.\dot{5}\dot{4} = \frac{10}{33}$$

(b) Using algebra, show that

$$4 \times 0.8\dot{5} \times 0.\dot{1}\dot{5} = \frac{14}{27}$$

(a) Using algebra, show that

$$0.\dot{7} \div 0.2\dot{1} = 3\frac{13}{19}$$

(b) Using algebra, show that

$$0.3\dot{5} \div 1.2\dot{7} = \frac{32}{115}$$

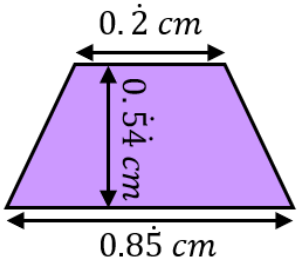
(a) Show that the mean of the three numbers

$$0.\dot{8}, 0.8\dot{1} \text{ and } 0.\dot{8}\dot{1}$$

can be written in its simplest form as a fraction $\frac{a}{b}$, where a and b are integers to be found.

(b) Using algebra, prove that the area of the trapezium shown is

$$\frac{97}{330}\ cm^2$$



Question 1: Use division to convert these fractions to recurring decimals.

(a) $\frac{1}{3}$ (b) $\frac{2}{3}$ (c) $\frac{4}{9}$ (d) $\frac{7}{9}$ (e) $\frac{1}{6}$ (f) $\frac{5}{6}$

(g) $\frac{3}{11}$ (h) $\frac{8}{15}$ (i) $\frac{5}{22}$ (j) $\frac{1}{7}$ (k) $\frac{1}{30}$ (l) $\frac{6}{7}$

Question 2: Convert the following recurring decimals to fractions.
Give each answer in its simplest form.

(a) 0.5555... (b) 0.1111... (c) 0.121212...

(d) 0.363636... (e) 0.919191... (f) 0.727272...

(g) 0.125125... (h) 0.621621... (i) 0.204204...

Question 3: Convert the following recurring decimals to fractions.
Give each answer in its simplest form.

(a) $0.\dot{2}$ (b) $0.\dot{8}$ (c) $0.\dot{1}\dot{8}$

(d) $0.\dot{5}\dot{3}$ (e) $0.\dot{7}\dot{5}$ (f) $0.\dot{6}\dot{3}$

(g) $0.\dot{1}1\dot{2}$ (h) $0.\dot{3}3\dot{9}$ (i) $0.\dot{1}7\dot{1}$

Question 4: Convert the following recurring decimals to fractions.
Give each answer in its simplest form.

(a) 0.53333... (b) 0.26666... (c) 0.08888...

(d) 0.1353535... (e) 0.4505050... (f) 0.9121212...

(g) 0.0152152... (h) 0.123333... (i) 0.354141414...

Question 5: Convert the following recurring decimals to fractions.
Give each answer in its simplest form.

(a) $0.2\dot{8}$ (b) $0.\dot{0}3$ (c) $0.\dot{9}6$ (d) $0.5\dot{2}\dot{1}$

(e) $0.3\dot{9}\dot{0}$ (f) $0.1\dot{2}3\dot{5}$ (g) $0.12\dot{6}$ (h) $0.5\dot{0}3\dot{5}$

Question 6: Convert the following recurring decimals to fractions.
Give each answer in its simplest form.

(a) 1.555... (b) 1.45454545... (c) 1.24444...

(d) 2.0717171... (e) 1.3599999... (f) 3.8123123...

Question 7: Convert the following recurring decimals to fractions.
Give each answer in its simplest form.

(a) $1.\dot{2}$ (b) $1.\dot{6}\dot{4}$ (c) $1.9\dot{2}$

(d) $2.0\dot{3}$ (e) $3.6\dot{5}\dot{9}$ (f) $8.6\dot{7}\dot{9}$

Apply

Question 1: Work out the following addition.
Give your answer as a simplified fraction

$$0.\dot{5} + 0.\dot{2}\dot{1}$$

Question 2: Work out the following
Give your answer as a simplified fraction

$$0.\dot{2}\dot{7} + 0.\dot{6}\dot{4} \div 0.5\dot{3}$$

Fluency Practice

Question 3: Arrange in order from smallest to largest.

$$\frac{61}{330} \qquad 0.1\dot{7}\dot{8} \qquad 3^{-2} \qquad \frac{19}{110}$$

Question 4: Mark is converting $0.2\dot{5}\dot{1}$ into a fraction.

Can you spot any mistakes?

$$\begin{aligned} x &= 0.2\dot{5}\dot{1} \\ x &= 0.2515151\ldots \\ 10x &= 2.515151\ldots \\ 100x &= 251.515151\ldots \\ 90x &= 249 \\ x &= \frac{249}{90} \end{aligned}$$

In each question, the variables x and y represent a single digit from 1 to 9. Give all your answers in their lowest terms.

1. Convert $0.\dot{x}$ to a fraction.
2. Convert $0.3\dot{x}$ to a fraction.
3. Convert $0.x\dot{5}$ to a fraction.
4. Convert $0.\dot{7}\dot{x}$ to a fraction.
5. Convert $0.\dot{x}\dot{y}$ to a fraction.
6. Work out $0.\dot{x}\dot{y} - 0.\dot{y}\dot{x}$, giving your answer as a fraction.
7. $0.\dot{x}\dot{y} - 0.\dot{y}\dot{x} = 0.\dot{5}\dot{4}$. How many possible pairs of values of x and y are there?
8. The fraction $\frac{1}{n}$, where n is a positive integer, is converted to a decimal. What values of n will give a terminating decimal? [Hint – use your calculator to try various values of n]
9. How many fractions of the form $\frac{1}{n}$, where n is an integer such that $1 \leq n \leq 30$, give a terminating decimal?
10. Giving your answer as a fraction, work out the value of

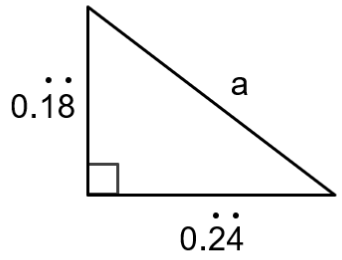
$$\frac{1}{10} + \frac{1}{100} + \frac{1}{1000} + \frac{1}{10000} + \cdots$$

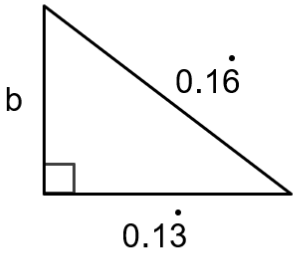
Fill in each box in the table with either "always recurring", "always terminating", or "sometimes recurring, sometimes terminating". Provide an example for each case.

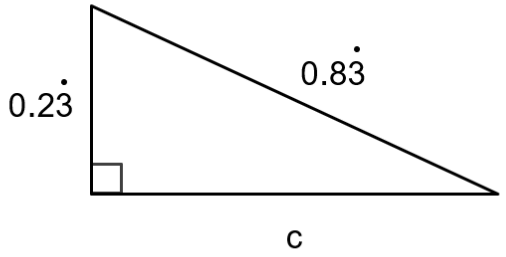
a	b	$a \times b$	$a + b$	$a \div b$
Recurring	Recurring			
Recurring	Terminating			
Terminating	Terminating			

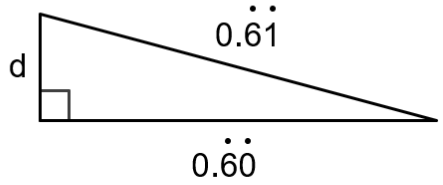
Fluency Practice

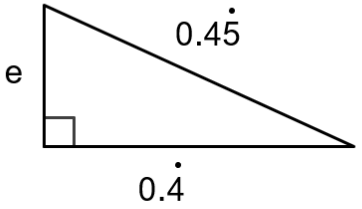
find the length of the missing side as a fraction in its simplest form

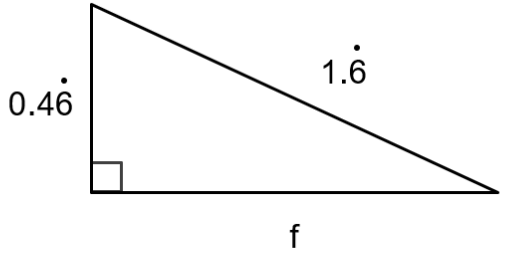


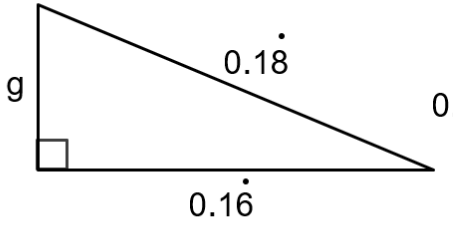


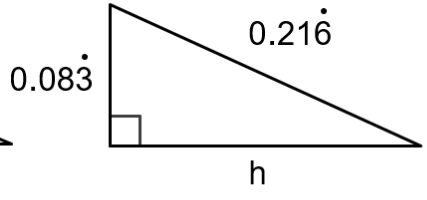


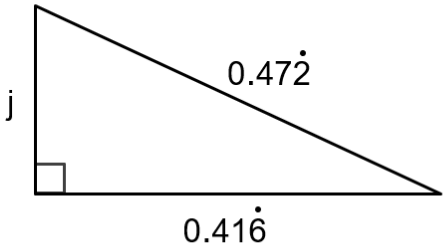












2 Advanced Straight Line Graphs (L2FM Only)

3 Parallel and Perpendicular Lines

Intelligent Practice

Write down the equation:

Parallel to the line	Goes through the point	Answer
$y = 3x + 2$	$(0,7)$	
$y = 3x + 2$	$(3,0)$	
$y = 3x + 2$	$(3,7)$	
$y = 3x + 10$	$(3,7)$	
$y = 2x - 2$	$(3,7)$	
$y = 2x - 2$	$(-3,7)$	
$y = 2x - 2$	$(0,0)$	

Decide whether each of these pairs of straight lines is parallel or not parallel:

(a) $y = 2x + 7$ and $y = 2x - 5$

(b) $y = 3x + 4$ and $y = 5x + 4$

(c) $y = 5x - 3$ and $y = 5x$

(d) $y = -4x + 1$ and $y = 4x + 2$

(e) $y = \frac{1}{2}x - 8$ and $y = 9 + \frac{1}{2}x$

(f) $y = -5 + 2x$ and $y = 5 - 2x$

(a) Write down the equation of the straight line that is parallel to $y = 4x - 1$ and passes through $(0, 5)$

(b) Write down the equation of the straight line that is parallel to $y = -2x + 7$ and passes through $(0, 3)$

(c) Write down the equation of the straight line that is parallel to $y = \frac{3}{4}x - 2$ and passes through $(0, -8)$

(d) Write down the equation of the straight line that is parallel to $y = \frac{7}{2}x + \frac{1}{2}$ and passes through the origin

(a) Write down the equation of the straight line that is parallel to $y = 1 - 3x$ and passes through $(0, -2)$

(b) Write down the equation of the straight line that is parallel to $y - 4x = 1$ and passes through $(0, -\frac{5}{2})$

(c) Write down the equation of the straight line that is parallel to $3x + y - 5 = 0$ and passes through $(0, 1)$

Match the pairs of parallel lines:

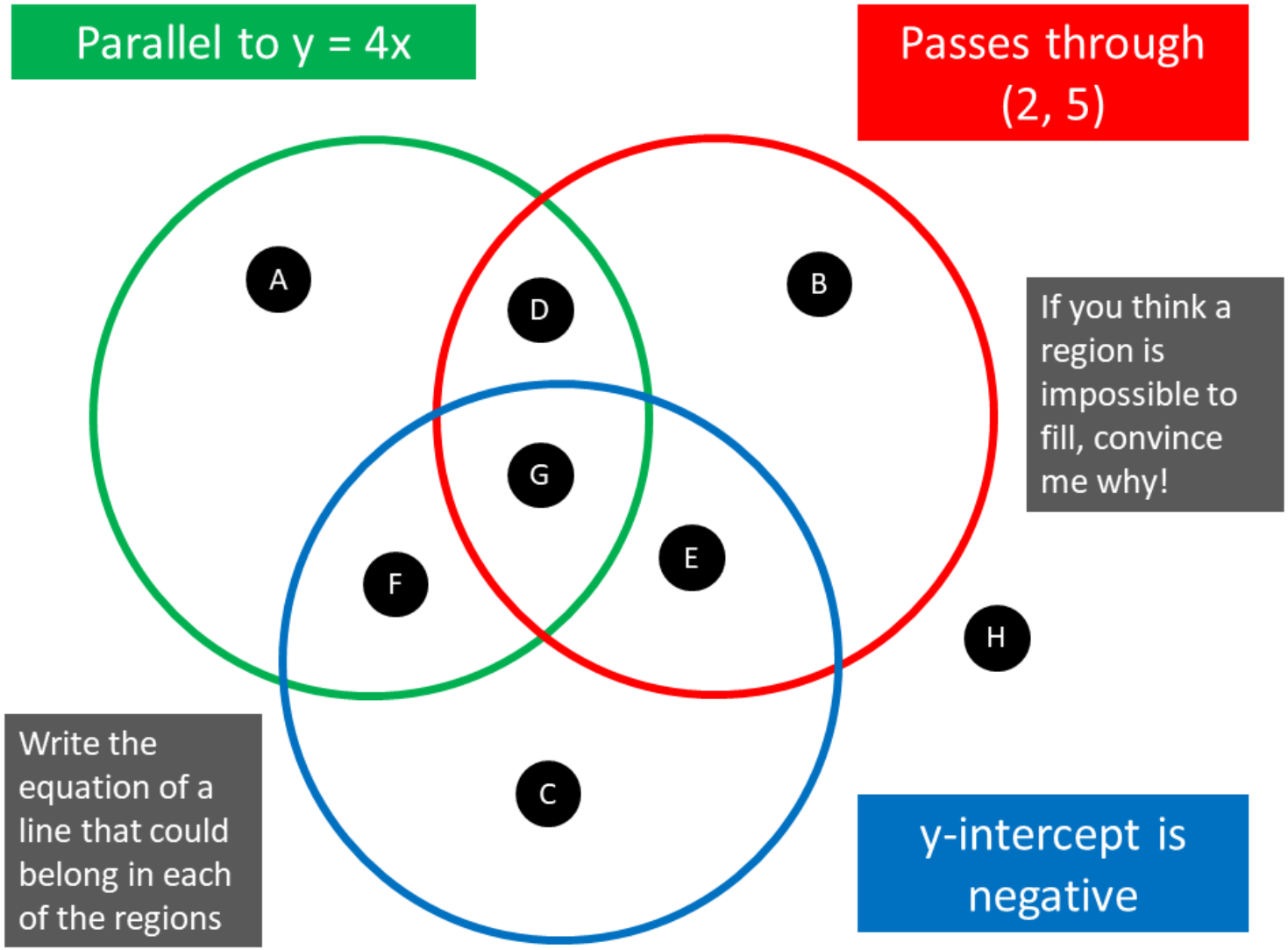
$y = -7x + 3$	$y + 3x = 7$
$7 + 3x = y$	$7x + y + 3 = 0$
$7y = 7 - 21x$	$y = 3x$

Line A passes through the points (2, 1) and (5, 10)
Find the equation of the line parallel to A that passes through (2,5) [3]

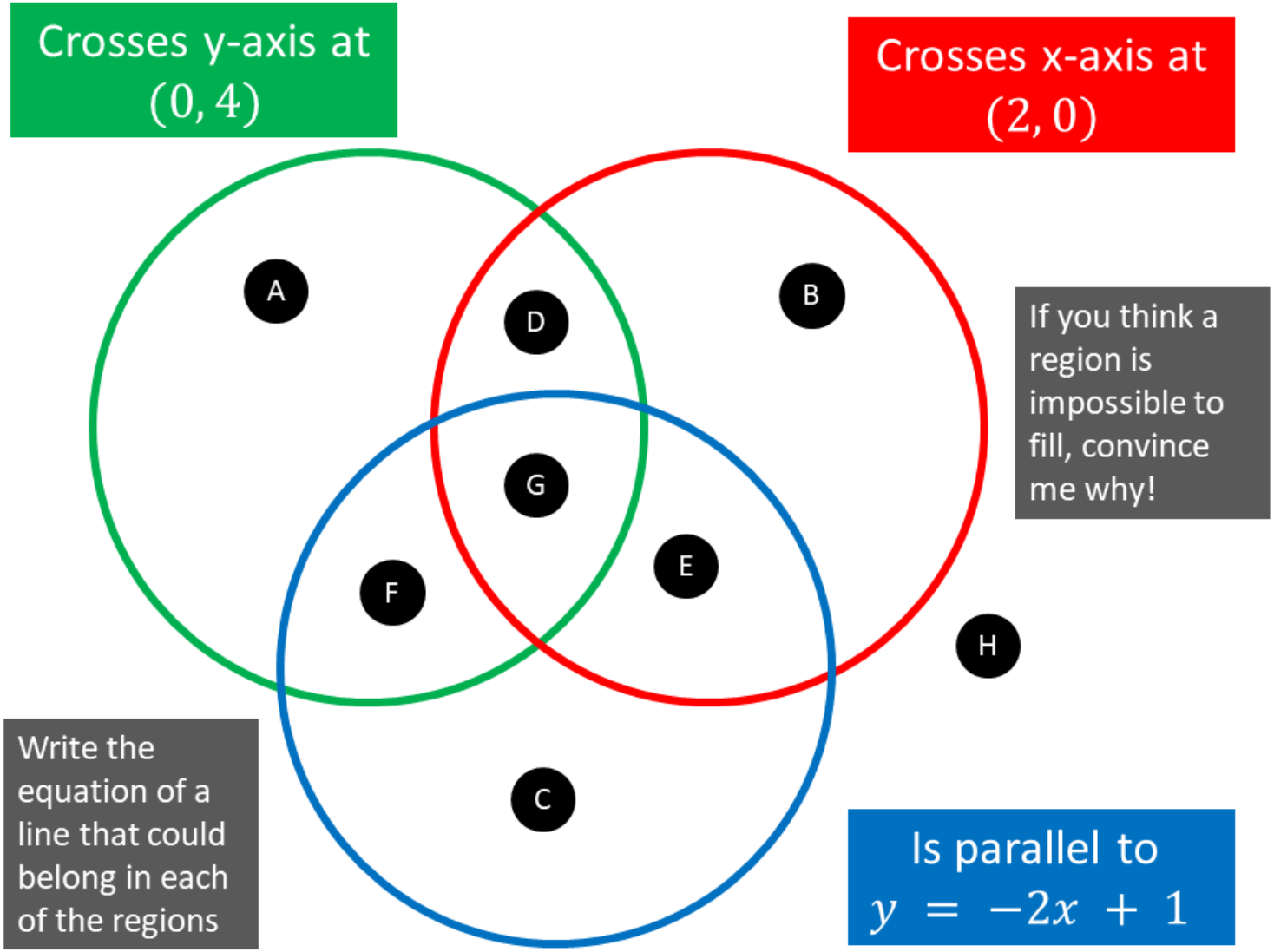
Line A passes through the points (2, 1) and (5, 10)
Line B passes through the points (4, 7) and (2, 1)
Show that Line A and Line B are parallel [4]

Line A passes through the points (3, 6) and (5, -2)
Line B passes through the points (2, 5) and (8, k)
Line A and Line B are parallel. Find the value of k. [4]

Maths Venns


Parallel to y = 4x
Passes through (2, 5)
A
D
B
If you think a region is impossible to fill, convince me why!
G
E
F
H
Write the equation of a line that could belong in each of the regions
C
y-intercept is negative

Maths Venns


Crosses y-axis at $(0, 4)$
Crosses x-axis at $(2, 0)$
A
D
B
G
F
E
H
C
If you think a region is impossible to fill, convince me why!
Write the equation of a line that could belong in each of the regions
Is parallel to $y = -2x + 1$

Intelligent Practice

Write down the equation:

Perpendicular to the line	Goes through the point	Answer
$y = -x + 2$	$(0,7)$	
$y = 2x + 2$	$(0,7)$	
$y = 2x + 2$	$(12,7)$	
$y = 3x + 2$	$(12,7)$	
$y = 3x + 2$	$(10,7)$	
$y = 3x + 2$	$(-12,7)$	
$y = 2x + 2$	$(0,0)$	

Find the equation of the line that has:

(a) Gradient 2 and goes through (0, 5)

(b) Gradient -3 and goes through (0, 7)

(c) Gradient $\frac{2}{3}$ and goes through (0, 4)

(d) Gradient -4 and goes through (0, -1)

(e) Gradient 1 and goes through (0, -6)

Find the equation of the line that is:

(a) Parallel to the line $y = 4x + 7$ and passes through (0, 2)

(b) Parallel to the line $y = -2x + 4$ and passes through (0, 6)

(c) Parallel to the line $y = 3x + 1$ and passes through (0, -4)

(d) Parallel to the line $y = x + 6$ and passes through (0, 5)

(e) Parallel to the line $y = \frac{1}{2}x + 3$ and passes through (0, -1)

Find the equation of the line that is:

(a) Perpendicular to the line $y = 2x + 5$ and passes through (0, 7)

(b) Perpendicular to the line $y = \frac{1}{3}x + 4$ and passes through (0, -5)

(c) Perpendicular to the line $y = -5x + 1$ and passes through (0, 2)

(d) Perpendicular to the line $y = -\frac{1}{4}x + 5$ and passes through (0, -4)

(e) Perpendicular to the line $y = 3x - 1$ and passes through (0, 3)

Match the pairs of perpendicular lines.

$x = 6$ $\quad x + y = 5$ $\quad y = 8x - 9$

$2y = x + 4$ $\quad 2x + y = 9$ $\quad y = -\frac{1}{8}x + 6$

$5y = 2x + 15$ $\quad y = 0.1x + 2$ $\quad y = -2$

$y = 33 - 10x$ $\quad 2y + 5x = 2$ $\quad y = x + 4$

Fluency Practice

Equation of line l_1	Two points that l_1 passes through.		Equation of a line perpendicular to l_1, through point A, in the form $ax + by + c = 0$
	Point A	Point B	
$2x + 3y - 5 = 0$	$(-5, a)$ a	$(b, -5)$ $b =$	
	$(-4,1)$	$(-3, -2)$	
	$(a, 1)$ $a =$	$(b, 3)$ $b =$	$x + 3y - 3 = 0$
$-x + 6y + 17 = 0$		$(b, -2)$ $b =$	$6x + y - 65 = 0$

Exam Questions

Write down the equation of a line perpendicular to $y = 3x + 3$ [1]

Write down the equation of the line perpendicular to $y = \frac{1}{2}x + 4$ which passes through (0,7) [2]

Line A passes through the points (-3, -1) and (-1, 9).
Line B passes through the points (-2, 1) and (k, 4).
Line A and Line B are perpendicular.
Find the value of k. [4]

Fluency Practice

In each question you will need to use the formula $y=mx+c$.

Find the equation of the line perpendicular to the line $y=2x+3$ and passes through the point (4,11)

Where does the line cross the x and y axis?

Find the equation of the line perpendicular to the line $y=3x-5$ and passes through the point (3,4)

Where does the line cross the x and y axis?

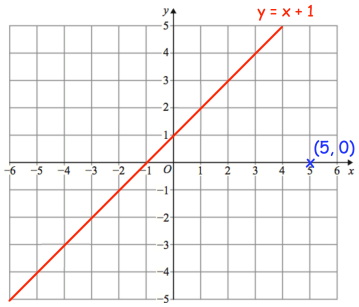
Find the equation of the line perpendicular to the line $y=-2x+8$ and passes through the point (6,-4)

Find the equation of the line perpendicular to the line $y=-3x+5$ and passes through the point (6,-13)

Find the equation of the line perpendicular to the line $y=\frac{1}{2}x+4$ and passes through the point (6,7)

Find the equation of the line perpendicular to the line $y=5x-9$ and passes through the point (10,41)

Question 1: Shown on the grid is the line, $y = x + 1$, and the point (5, 0)



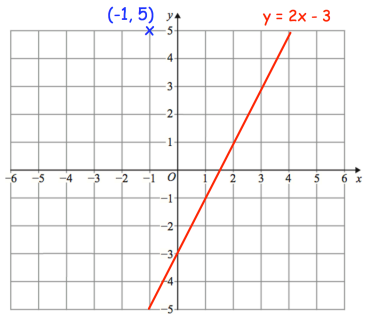
(a) Find the gradient of a line perpendicular to $y = x + 1$

(b) Find the equation of the line perpendicular to $y = x + 1$ that passes through the point (5, 0)

(c) Find the point where your answer to (b) and the line $y = x + 1$ intersect.

(d) Calculate the distance between your answer to (c) and the point (5, 0)

Question 2: Shown on the grid is the line, $y = 2x - 3$, and the point (−1, 5)



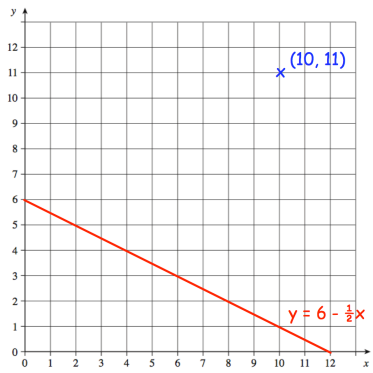
(a) Find the gradient of a line perpendicular to $y = 2x - 3$

(b) Find the equation of the line perpendicular to $y = 2x - 3$ that passes through (−1, 5)

(c) Find the point where your answer to (b) and the line $y = 2x - 3$ intersect.

(d) Calculate the distance between your answer to (c) and the point (−1, 5)

Question 3: Shown on the grid is the line, $y = 6 - \frac{1}{2}x$ and the point (10, 11)



(a) Find the equation of the line perpendicular to $y = 6 - \frac{1}{2}x$ that passes through (10, 11).

(b) Find where your answer to (a) intersects $y = 6 - \frac{1}{2}x$

(c) Calculate the shortest distance between the (10, 11) and the line $y = 6 - \frac{1}{2}x$

Question 4: Calculate the shortest distances between the following lines and points.

(a) The line $y = -x + 2$ and the point (8, 4)

(b) The line $y = 4x + 7$ and the point (−13, 6)

(c) The line $x - 3y + 9 = 0$ and the point (5, 38)

Question 5: Calculate the shortest distances between the following lines and points.

(a) The line $y = 5x + 1$ and the point (3, 3)

(b) The line $y = -2x - 15$ and the point (−1, −4)

(c) The line $2x + y + 5 = 0$ and the point (0, 0)

Apply

Question 1: The line L_1 has equation $y = 2x - 4$
The line L_2 has equation $y = -3x + 11$
The line L_3 has equation $y = x$
L_1 and L_2 meet at the point A.

Work out the shortest distance between the line L_3 and the point A.

Question 2: ABC is a triangle.
A is the point (−5, 2)
B is the point (0, 8)
C is the point (9, 3)

Work out the area of triangle ABC.

PAR. or PERP. ?

For lines 1-10, which line is **PARALLEL** and which is **PERPENDICULAR**?

L_1	$y = 5 - x$	$2y = 4x - 6$	$y + x = 3$	$y = x + 5$
L_2	$y = 3x + 5$	$y = 6 - \frac{x}{3}$	$y = 5x - 3$	$y = 5 + 3x$
L_3	$y = 4 - 2x$	$y + 2x = 7$	$y = 2x - 3$	$2y = x - 3$
L_4	$x + y = 7$	$2y = 5 - x$	$y = \frac{x}{2} - 6$	$x + y = 6$
L_5	$2y = 4x - 5$	$y - 2x = 8$	$y - 3x = 9$	$y = 1 - \frac{1}{2}x$
L_6	$y - 3x = 8$	$3y = 6 - x$	$2y - 6x = 10$	$6x + 3y = 7$
L_7	$2x + y = 4$	$4y - 6x = 9$	$y = \frac{x}{2} - 3$	$4x + 2y = 7$
L_8	$2y = x - 10$	$4y = 2x + 7$	$3y - x = 6$	$2y = 10 - 4x$
L_9	$4y + x = 16$	$3y - 12x = 3$	$8y = 4 - 2x$	$2y + 4x = -3$
L_{10}	$4y - 3x = 12$	$8y = 12 - 6x$	$6y + 8x = 5$	$8 = 3x - 4y$

Decide whether each of these pairs of lines is perpendicular, parallel or neither:

(a) $y = 2x - 1$ and $y = -\frac{1}{2}x + 5$

(b) $y = \frac{1}{3}x + 2$ and $y = \frac{1}{3}x - 4$

(c) $y = 1 - 4x$ and $y = -\frac{1}{4}x + \frac{3}{4}$

(d) $y = \frac{2}{3}x$ and $y = -\frac{3}{2}x - 6$

(a) Write down the equation of the straight line that is perpendicular to the line $y = -3x + 1$ and passes through $(0, 2)$

(b) Write down the equation of the straight line that is perpendicular to the line $y = \frac{1}{4}x - 5$ and passes through $(0, 7)$

(c) Write down the equation of the straight line that is perpendicular to the line $y = -\frac{1}{2}x$ and passes through $(0, -4)$

(a) Write down the equation of the straight line that is perpendicular to the line $y = 4 - 5x$ and passes through $(0, -8)$

(b) Write down the equation of the straight line that is perpendicular to the line $y + 3x = 9$ and passes through $(0, 0)$

(c) Write down the equation of the straight line that is perpendicular to the line $2y = -5x + 6$ and passes through $(0, 4)$

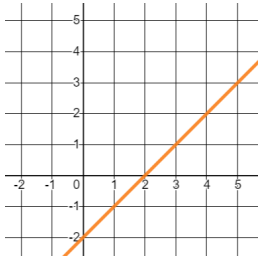
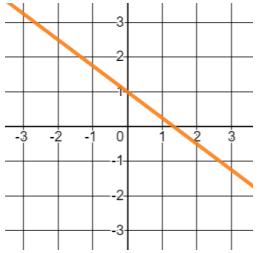
Match the pairs of perpendicular lines:

$y = \frac{2}{3}x - 1$	$y = \frac{1}{2}x + \frac{3}{2}$
$y - 3x = 2$	$2 - 3x = 2y$
$3 - 2x = y$	$3y + x + 2 = 0$

Fluency Practice

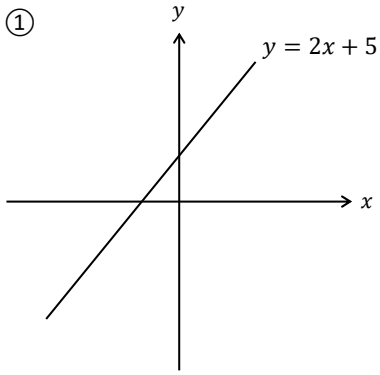
Coordinates and Straight Lines			
(a)	**(b)**	**(c)**	**(d)**
Write down the gradient of the line with equation $y = -3x + 5$	Write down the y-intercept of the line with equation $y = 5x - 1$	Write down the gradient of the line with equation $y = \frac{2}{3}x - 1$	Write down the y-intercept of the line with equation $y = 6 - 5x$
(e)	**(f)**	**(g)**	**(h)**
Write down the equation of the line with gradient 4 and y-intercept $(0, -3)$	Find the midpoint of the line segment joining $(5, 2)$ and $(9, -2)$	Write down the equation of the line with y-intercept $(0, 7)$ and gradient $-\frac{1}{2}$	Find the equation of the line parallel to $y = 3x - 1$ that passes through $(0, 6)$
(i)	**(j)**	**(k)**	**(l)**
Find the midpoint of the line segment joining $(-4, 1)$ and $(-8, 5)$	Find the length of the line joining $(3, 1)$ and $(7, 4)$	Find the equation of the line parallel to $y = -\frac{3}{2}x$ that passes through $(0, 5)$	Find the length of the line joining $(-1, 3)$ and $(4, 12)$
(m)	**(n)**	**(o)**	**(p)**
Find the equation of the line with gradient 2 that passes through $(5, 3)$	Find the equation of the line parallel to $y = -3x$ that passes through $(2, 4)$	Find the equation of the line that passes through $(5, 4)$ and $(3, 10)$	Find the equation of the line that is perpendicular to $y = -2x + 1$ and passes through $(-3, 5)$

Fluency Practice

(a)	(b)	(c)	(d)
Write down the gradient and y-intercept of the straight line with equation $y = 5x - 2$	Write down the gradient and y-intercept of the straight line with equation $y = -\frac{1}{2}x + 7$	Write down the gradient and y-intercept of the straight line with equation $3y = 2x - 9$	Find the gradient of the line joining $(2, 5)$ and $(4, 11)$
(e)	**(f)**	**(g)**	**(h)**
Find the equation of the line. 	Find the equation of the line. 	Write down the equation of the line that is parallel to $y = -4x - 9$ and passes through $(0, 2)$	Write down the equation of the line that is perpendicular to $y = -3x$ and passes through the point $(0, -5)$

(i)	(j)	(k)
Find the equation of the line that has a gradient of 2 and passes through $(4, 3)$	Find the equation of the line that is perpendicular to the line $2y = x - 8$ and passes through $(-1, 9)$	Find the equation of the line that passes through $(2, 9)$ and $(5, 3)$.

Fluency Practice

① 

On the axes, sketch the graphs:

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

$y = \frac{x}{2} + 5$

② $y = 3x + 5$

Gradient = _____

y-intercept = _____

$y = 8 - 2x$

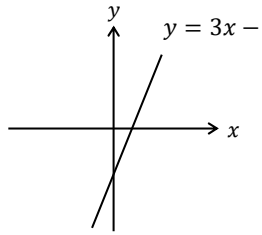
Gradient = _____

y-intercept = _____

$2y + x = 7$

Gradient = _____

y-intercept = _____

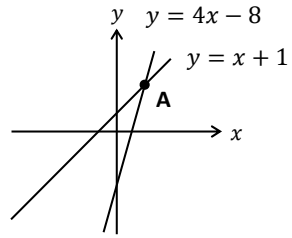
③ 

Which coordinates are on this graph?

(4, 8) (0, 4) (−2, −2)

Complete these coordinates for the graph $2y = 5x + 2$

$(4, y)$ $(x, 6)$ $(x, -9)$

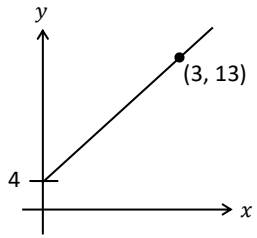
④ 

Find the coordinates of point **A**.

Find the coordinates of the point where the graphs $y = 3x + 9$ & $y = \frac{x}{2} + 4$ intersect.

⑤ Line N is parallel to the graph $y = 5x - 7$ & passes through (4, 22). Find the equation of Line N

Line O is parallel to the graph $y = 5 - 2x$ & passes through (5, −13). Find the equation of Line O

⑥ 

Find the equation of this line.

Line P passes through (1, 3) & (3, 11). Find the equation of this line.

Line Q passes through (−2, 10) & (5, −4). Find the equation of this line.

⑦ $y = 2x + 5$

Find the gradient of a line perpendicular to this graph.

$y = 10 - 4x$

Find the gradient of a line perpendicular to this graph.

$3y + 2x = 7$

Find the gradient of a line perpendicular to this graph.

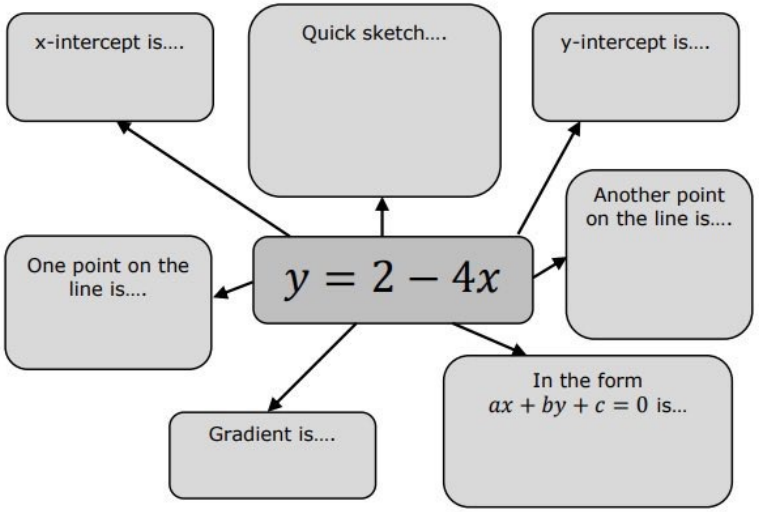
⑧ Line R is perpendicular to the graph $y = 2x + 4$ & passes through (8, 2). Find the equation of Line R

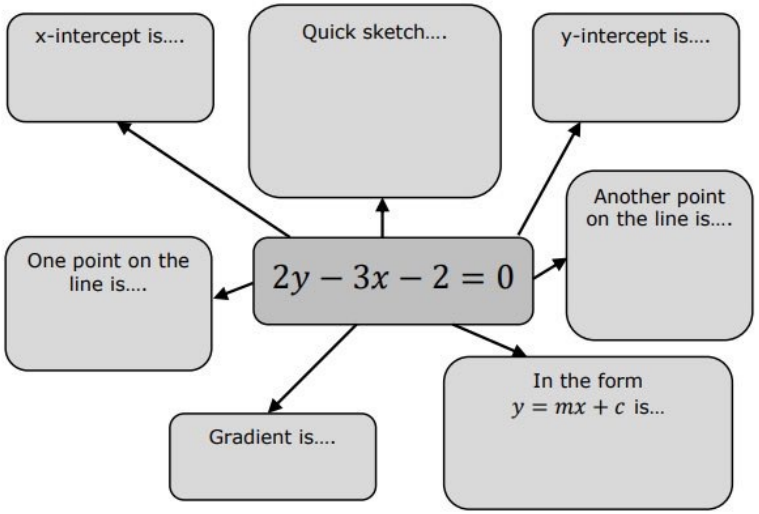
Line S passes through (4, 6) & (8, 8) Line T is perpendicular to this line & passes through its midpoint. Find the equation of Line T.

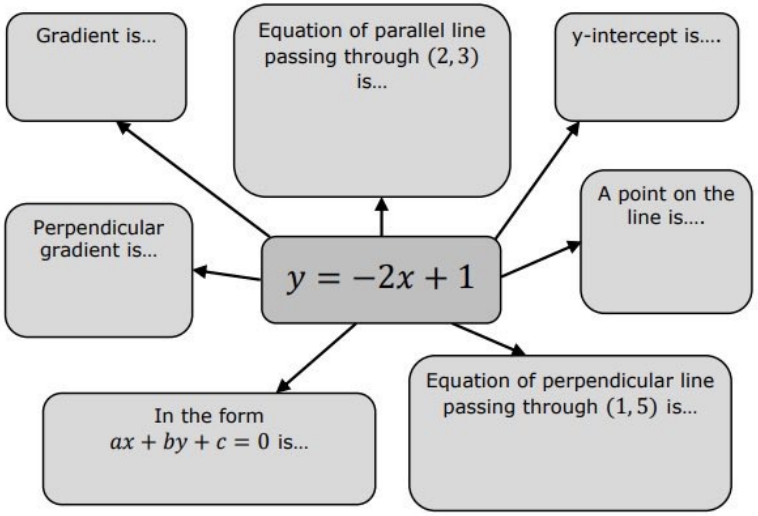
Fluency Practice

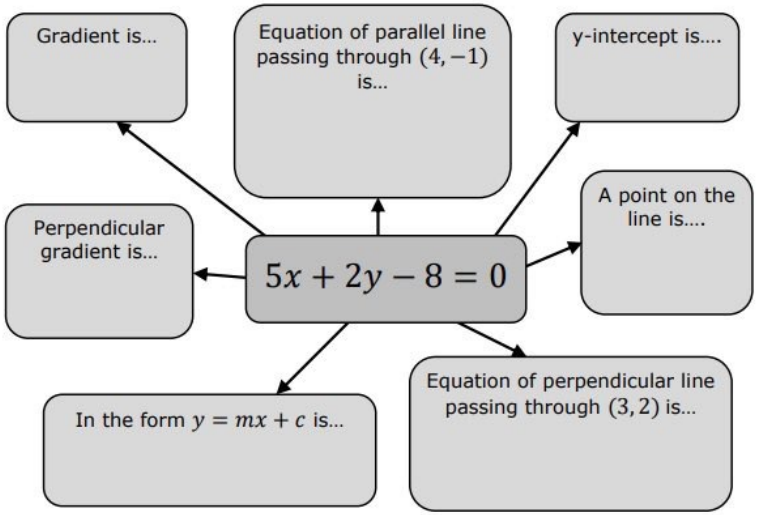
Harder Coordinate Geometry		
(a)	**(b)**	**(c)**
Find an equation of the line that passes through the points $(4, 2)$ and $(-8, 11)$. Give your answer in the form $ax + by = c$ where a, b and c are integers.	The straight line L has equation $5x - 3y = 18$. Find an equation of the line that is parallel to L and crosses the x-axis at $(4, 0)$.	The straight line L_1 has equation $x + 2y - 7 = 0$. The straight line L_2 passes through the points $(-2, -6)$ and $(5, 8)$. Show that the lines L_1 and L_2 are perpendicular to each other.
(d)	**(e)**	**(f)**
The straight line L passes through the points $(1, -1)$ and $(5, 9)$. Find an equation of the line that is parallel to L and passes through the point $(2, 4)$. Give your answer in the form $ax + by + c = 0$ where a, b and c are integers.	The straight line L_1 has equation $2x - 3y = 4$. The straight line L_2 is perpendicular to L_1 and passes through the point $(1, 2)$. Find the equation of the line L_2 and the coordinates of the point where it crosses the x-axis.	ABC is a triangle, where $\widehat{BAC} = 90°$. The point C has coordinates $(9, 5)$ and points A and B lie on the line with equation $2x + 3y = 7$. Find the equation of the line that passes through A and C, giving your answer in the form $ax + by = c$ where a, b and c are integers.

Fluency Practice









Find the midpoints of the line segments joining:

(a) (4, 5) and (8, 1)

(b) (6, 0) and (12, 4)

(c) (8, -2) and (4, -10)

(d) (3, -1) and (-5, 1)

(e) (4, 7) and (3, 3)

(f) (9, -1) and (6, 3)

(g) (0, 5) and (-4, 8)

(h) (-2, -3) and (4, -4)

(i) (1.5, 3) and (7.5, 2.5)

(j) (-3.5, 9) and (-2.5, 4)

Find the lengths of the line segments joining:

(a) (1, 1) and (4, 5)

(b) (8, 4) and (2, -4)

(c) (-2, 5) and (3, 17)

(d) (6, 3) and (5, -4)

(e) (4, 7) and (3, 3)

(f) (9, -1) and (6, 3)

(g) (0, 5) and (-4, 8)

(h) (-2, -3) and (4, -4)

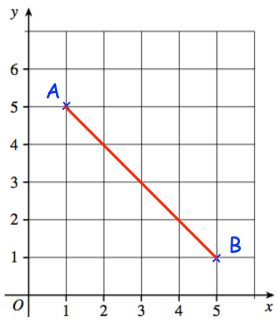
The line segment AB has the midpoint (7, 5). If point A is (3, 4), what are the coordinates of point B?

The line segment CD has the midpoint (-2, 4). If point D is (5, -1), what are the coordinates of point C?

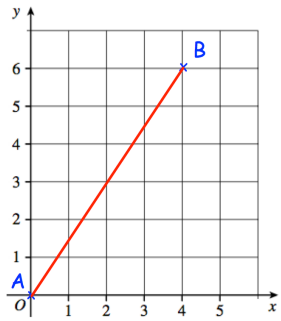
The line segment AB has length 10. If point A is (8, 11), find as many possible positions for point B as you can.

Question 1: Find the coordinates of the midpoints of the following line segments.

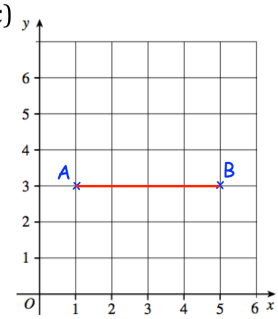
(a)



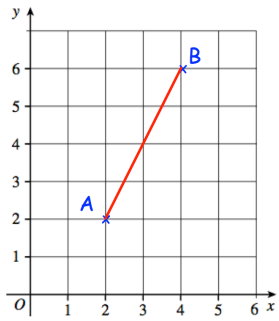
(b)



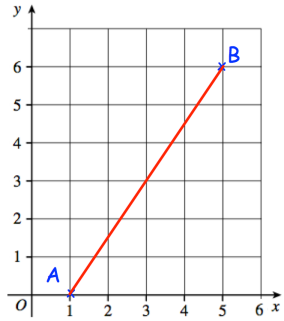
(c)



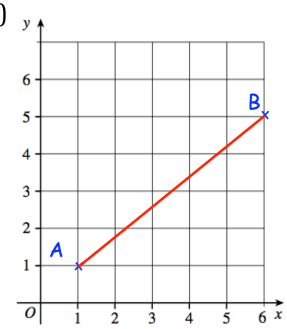
(d)



(e)

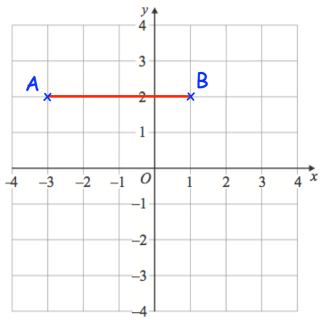


(f)

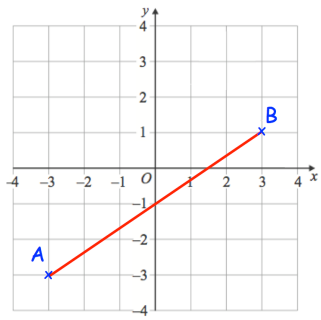


Question 2: Find the coordinates of the midpoints of the following line segments.

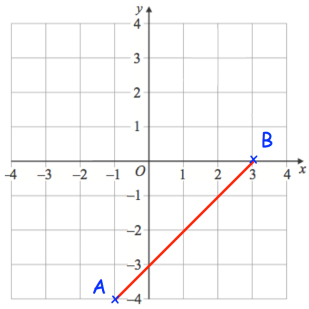
(a)



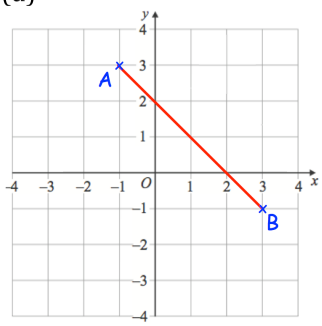
(b)



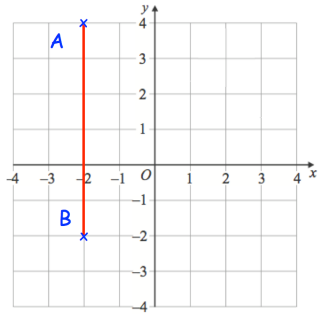
(c)



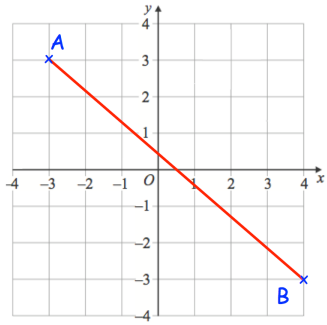
(d)



(e)



(f)



Question 3: Find the midpoint of the line joining these pairs of points

(a) (2, 4) and (6, 10)

(b) (1, 4) and (9, 12)

(c) (0, 7) and (6, 1)

(d) (−5, 2) and (5, −4)

(e) (−3, 9) and (7, −1)

(f) (0, −4) and (9, 0)

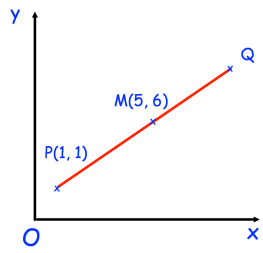
(g) (−10, −6) and (−2, 8)

(h) (0, 5) and (−11, −10)

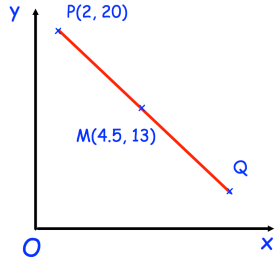
(i) (9, 8) and (4, 8)

Question 4: M is the midpoint of PQ in each diagram below.
Find the coordinates of Q in each diagram.

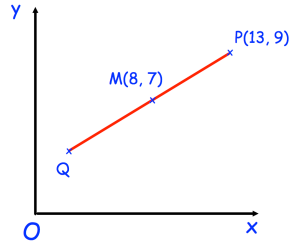
(a)



(b)

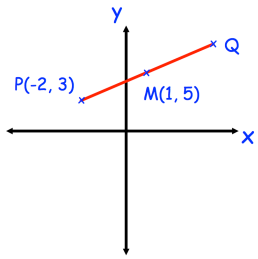


(c)

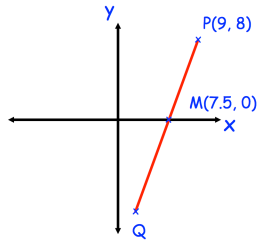


Question 5: M is the midpoint of PQ in each diagram below.
Find the coordinates of Q in each diagram.

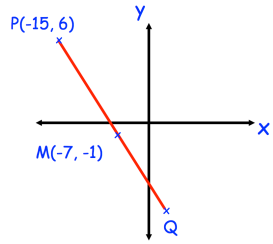
(a)



(b)

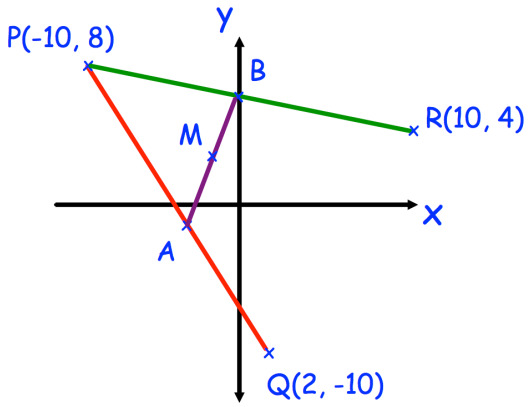


(c)



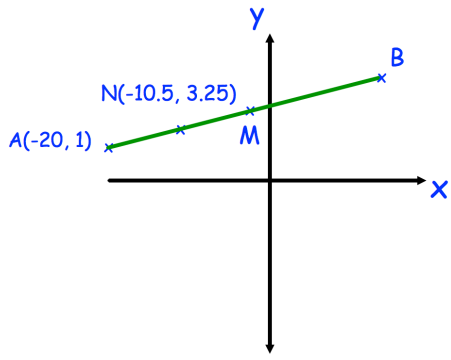
Apply

Question 1: A is the midpoint of the line PQ.
B is the midpoint of the line PR.
M is the midpoint of the line AB.
Find the coordinates of the point M



Question 2: M is the midpoint of the line AB.
The coordinates of the point M are (7, 2)
The coordinates of the point B are (11, 8)
The coordinates of the point C are (7, −4)
Find the area of triangle ACM.

Question 3: M is the midpoint of AB.
N is the midpoint of AM.
Find the coordinates of the point B.



(a) A line segment joins point A (1, 2) to point B (4, 8). Point C divides the line segment in the ratio AC : CB = 2 : 1. Find the coordinates of point C.
(b) A line segment joins point A (3, 1) to point B (11, 5). Point C divides the line segment in the ratio AC : CB = 3 : 1. Find the coordinates of point C.
(c) A line segment joins point A (3, 2) to point B (8, 12). Point C divides the line segment in the ratio AC : CB = 1 : 4. Find the coordinates of point C.

(a) A line segment joins point A (2, -3) to point B (5, 9). Point C divides the line segment in the ratio AC : CB = 2 : 1. Find the coordinates of point C.
(b) A line segment joins point A (6, -4) to point B (11, 6). Point C divides the line segment in the ratio AC : CB = 3 : 2. Find the coordinates of point C.
(c) A line segment joins point A (-8, -7) to point B (12, 3). Point C divides the line segment in the ratio AC : CB = 2 : 3. Find the coordinates of point C.

(a) A line segment joins point A (9, -1) to point B (5, 7). Point C divides the line segment in the ratio AC : CB = 1 : 7. Find the coordinates of point C.
(b) A line segment joins point A (1, 5) to point B (-5, 2). Point C divides the line segment in the ratio AC : CB = 5 : 1. Find the coordinates of point C.

A line segment joins point A (5, 2) with point B. Point C with coordinates (4, 4) divides the line segment in the ratio AC : CB = 1 : 3. Find the coordinates of B.

Fluency Practice

dividing a line segment in a ratio

(1) A is the point (4, 3)
C is the point (22, 27)

B divides the line segment AC in the ratio 1 : 2
find the coordinates of B

(2) P is the point (1, 3)
R is the point (11, 18)

Q divides the line segment PR in the ratio 1 : 1½
find the coordinates of Q

(3) Q is the point (5, 2)
R is the point (9, 10)

Q divides the line segment PR in the ratio 1 : 2
find the coordinates of P

(4) P is the point (– 5, 11)
R is the point (16, – 3)

Q divides the line segment PR in the ratio 3 : 4
find the coordinates of Q

(5) A is the point (– 1, – 7)
C is the point (24, 23)

B divides the line segment AC in the ratio 2 : 3
find the coordinates of B

(6) A is the point (– 2, – 4)
C is the point (22, 4)

B divides the line segment AC in the ratio 5 : 3
find the coordinates of B

Question 1: Write down the equation of a line parallel to each of the following

(a) $y = 2x + 3$ (b) $y = 5x - 3$ (c) $y = -3x + 1$ (d) $y = x - 7$

(e) $y = -7x - 10$ (f) $y = -x$ (g) $y = 10x$ (h) $y = 4$

(i) $x + y = 5$ (j) $2x + y - 1 = 0$ (k) $x - 2y + 5 = 0$ (l) $3x - 4y - 9 = 0$

Question 2: Write down the equation of each of the following lines

(a) Parallel to $y = 3x + 5$ and passing through $(0, 2)$

(b) Parallel to $y = 4x - 1$ and passing through $(0, 6)$

(c) Parallel to $y = 5x$ and passing through $(0, -3)$

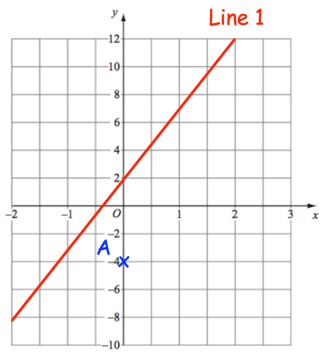
(d) Parallel to $y = -2x + 10$ and passing through the origin

(e) Parallel to $x + y = 8$ and passing through $(0, -4)$

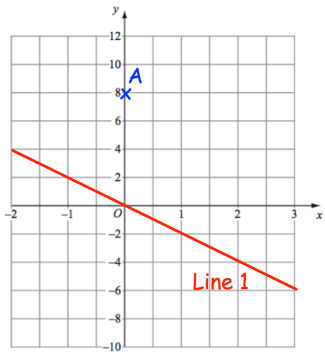
(f) Parallel to $x - 2y + 3 = 0$ and passing through $(0, 5)$

Question 3: Write down the equation of the line parallel to Line 1 and passing through A.

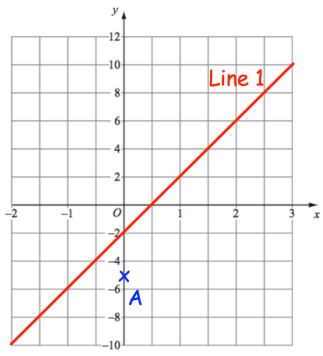
(a)



(b)



(c)



Question 4: Write down the equation of each of the following lines

(a) Parallel to $y = 2x - 1$ and passing through (1, 8)

(b) Parallel to $y = 3x + 2$ and passing through (1, 1)

(c) Parallel to $y = 5x - 4$ and passing through (2, 9)

(d) Parallel to $y = 3x - 7$ and passing through (4, 15)

(e) Parallel to $y = 4x$ and passing through (−1, 3)

(f) Parallel to $y = -2x + 5$ and passing through (−3, 0)

(g) Parallel to $y = 6x + 3$ and passing through (10, 5)

(h) Parallel to $y = -\frac{1}{2}x + 1$ and passing through (3, 0)

(i) Parallel to $x + y = 10$ and passing through (4, 0)

(j) Parallel to $x - 3y - 6 = 0$ and passing through (−9, −2)

Question 5: Write down the negative reciprocal of each number below.

(a) 4 (b) $\frac{2}{3}$ (c) -6 (d) 8 (e) $\frac{1}{2}$ (f) 1

(g) $-\frac{1}{3}$ (h) $-\frac{2}{5}$ (i) $\frac{4}{7}$ (j) $1\frac{1}{2}$ (k) -1 (l) $-1\frac{3}{4}$

Question 6: Write down the equation of a line perpendicular to each of the following

(a) $y = 4x + 2$ (b) $y = 2x - 7$ (c) $y = -5x + 2$ (d) $y = x - 3$

(e) $y = -x + 1$ (f) $y = \frac{1}{2}x + 3$ (g) $y = \frac{3}{4}x - 2$ (h) $y = -\frac{1}{5}x + 1$

(i) $y = -\frac{2}{3}x - 5$ (j) $x + y = 12$ (k) $x - 2y + 8 = 0$ (l) $5x - 3y - 3 = 0$

Question 7: Write down the equation of each of the following lines

(a) Perpendicular to $y = 2x + 4$ and passing through (0, 3)

(b) Perpendicular to $y = -3x - 8$ and passing through (0, −2)

(c) Perpendicular to $x + y = 6$ and passing through (0, 1)

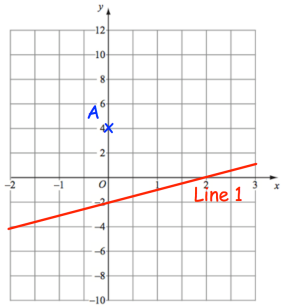
(d) Perpendicular to $y = \frac{1}{3}x - 2$ and passing through the origin

(e) Perpendicular to $y = -\frac{1}{5}x + 8$ and passing through (0, −2)

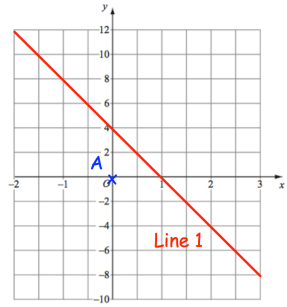
(f) Perpendicular to $y = -\frac{2}{9}x - 10$ and passing through (0, 6)

Question 8: Write down the equation of the line perpendicular to Line 1 & passing through A.

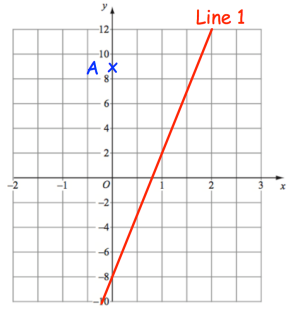
(a)



(b)



(c)



Question 9: Write down the equation of each of the following lines

(a) Perpendicular to y = 2x − 1 and passing through (4, 0)

(b) Perpendicular to y = −3x + 4 and passing through (6, 1)

(c) Perpendicular to y = 4x and passing through (−12, 5)

(d) Perpendicular to y = −½x + 1 and passing through (3, −7)

(e) Perpendicular to y = ⅔x + 4 and passing through (−6, −4)

(f) Perpendicular to y = −⅗x − 2 and passing through (9, 9)

(g) Perpendicular to x + 4y − 6 = 0 and passing through (1, 8)

Apply

Question 1: Write down the equations of the lines, from the box, that are:

y = 2x	y = ½x + 1
y = 3x + 2	y = -5x
y = 5x - 4	y = -2x + 3
	y = 3x - 2

(a) parallel (b) perpendicular (c) cross the y−axis at (0, 3)

(d) pass through the origin (e) pass through the point (1, 1)

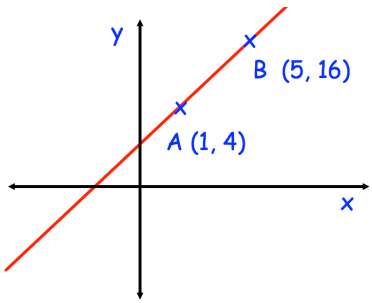
Question 2: Are the lines $2x + y = 8$ and $y = 2x + 5$ parallel?

Question 3: Are the lines $4x - y - 5 = 0$ and $x + 4y + 1 = 0$ perpendicular?

Question 4: A straight line passes through the points A(1, 4) and B(5, 16).

(a) Find the equation of the line parallel to AB that passes through (1, 7)

(b) Find the equation of the line perpendicular to AB that passes through the midpoint of AB.



Question 5: The line L has equation $y = 2x + 8$
The line L crosses the x–axis at the point A.
The line M is perpendicular to Line L and passes through the point A

(a) Find the coordinates of the point A.
(b) Find equation of the Line M.

Question 6: The point A has coordinates (−12, −7) and the point B has coordinates (−8, 1)

Find the equation of the line parallel to AB and passing through (2, 5)

Question 7: The line L passes through the points (−2, 1) and (2, 3).
The line N passes through the points (4, 7) and (12, 11).

Bryan says that the lines L and N are parallel.
Is Bryan correct? Explain your answer.

Question 8: The point C has coordinates (2, −3) and the point D has coordinates (4, 6).

Find the equation of the line perpendicular to CD and passing through D.

Question 9: The line Q passes through the points (−10, −2) and (−8, −8)
The line R passes through the points (1, 2) and (10, a)

The lines Q and R are perpendicular.

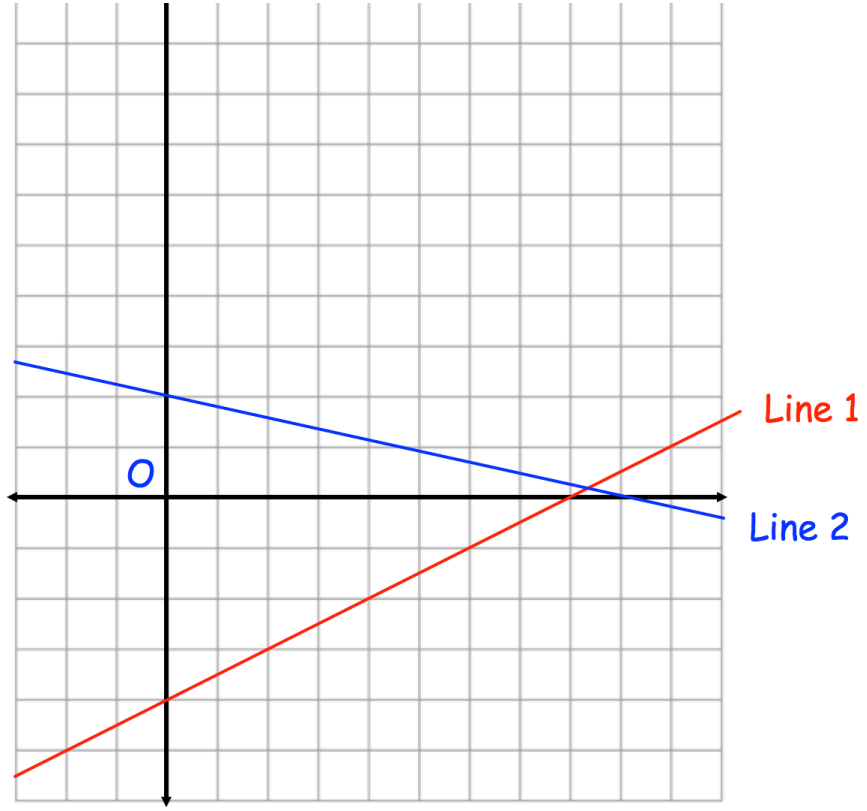
Find a.

Question 10: Two straight lines are shown.

Line 1 has equation $y = \frac{3}{2}x - 24$

(a) Find the equation of Line 2

(b) Are the lines perpendicular?



Fluency Practice

perpendiculars

based on CBSE(10) exam questions

(1) prove that the triangle with vertices:
A (3, 0), B (6, 4) and C (– 1, 3)
is right–angled
show that it is also isosceles

(2) triangle ABC is isosceles with $AC = BC$
if A = (3, – 2) and B = (5, 2)
and the coordinates of C are (12, k)
a) find the value of k
b) find the area of triangle ABC

(3) triangle ABC has vertices:
A = (3, 3), B = (3, – 7) and C = (6, – 6)
a) show that the triangle is right-angled
b) show that the centre of the circle that passes through A, B and C lies on AB
c) find the area of triangle ABC

(4) a) which point on the y–axis is equidistant from (5, – 3) and (– 4, 6) ?

b) which point on the x–axis is equidistant from (2, – 5) and (– 2, 9) ?

(5) the point P (x, y) is equidistant from
A (5, 1) and C (– 1, 5)
a) prove that $2y = 3x$
b) find the other two coordinates of the square $ABCD$

(6) the point P (x, y) is equidistant from
E (4, 3) and G (– 3, 4)
a) prove that $y = 7x$
b) find the other two coordinates of the square $EFGH$
c) which square, $ABCD$ (above) or $EFGH$ has the larger area?

(7) the point P (x, y) is equidistant from
A $(a + b, b - a)$ and
B $(a - b, a + b)$

prove that $ay = bx$

(8) the triangle with vertices:
A (4, 7), B (t, 6) and C (8, 1)
is right–angled at B

find the values of t

Fluency Practice

lines and perpendiculars

based on GCSE exam questions

(1) the straight line L_1 passes through the points with coordinates (4, 8) and (12, 4)
the straight line L_2 passes through the origin (O) and has gradient – 3

the two lines meet at point P
find the coordinates of P

the perpendicular to L_1 from the origin meets L_1 at Q

establish that $\triangle OPQ$ is an isosceles right angled triangle

what is its area?

(2) the point $P = (3, 4)$ and $Q = (a, b)$

a line perpendicular to PQ is: $3x + 2y = 7$

find an expression for b in terms of a
and give four possible coordinates for Q
[other than (3, 4)]

(3) PQR is a triangle with vertices P, Q and R
$P = (– 3, – 6)$, $Q = (1, 4)$ and R = (5, – 2)
M is the midpoint of PQ
N is the midpoint of QR

prove that MN is parallel to PR
establish that the length $MN = ½\ PR$

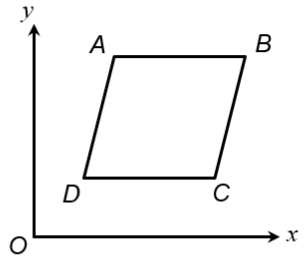
(4) $ABCD$ is a rhombus with $A = (5, 11)$
the equation of the diagonal DB is $y = ½\ x + 6$

find an equation of the diagonal AC

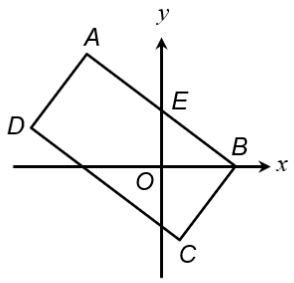
what are the coordinates of the centre of the rhombus?

what are the coordinates of (i) B (ii) D (iii) C ?

DC is parallel to the x axis



(5)



B is on the x axis

$ABCD$ is a rectangle
the equation of the line AB is $x + 2y = 12$

$AE = EB$

find an equation for AD

find an equation for DC

what are the coordinates of (i) A (ii) D (iii) C ?

Problem Solving

	All Sides Equal	Has 4 Right Angles	Diagonals Cross at Right Angles
Forms a Parallelogram			
Diagonals not Equal in Length			

Put these cards into the correct part of the table.

$y = 2x - 1$ $y = 2x - 11$ $2y = 3 - x$ $4y = -(2x - 16)$	$y = x + 3$ $y = x - 5$ $7y = -35 - 49x$ $7x = 35 - y$	**IT'S IMPOSSIBLE!**

There are 3 missing spaces. Create sets of equations for them.

Q1. $y = 5x - 4$ is the equation of a straight line.

(a) Write down the gradient of the line $y = 5x - 4$

Answer .....

(1)

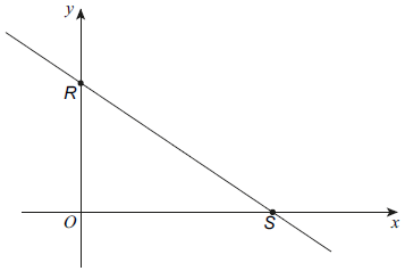
(b) Write down the coordinates of the y-intercept of the line $y = 5x - 4$

Answer (..... , ...)

(1)
(Total 2 marks)

Q2.

A sketch of $2x + 3y = 12$ is shown.



(a) Work out the coordinates of R.

Answer (....., ...)

(1)

(b) Work out the coordinates of S.

Answer (....., ...)

(2)
(Total 3 marks)

Q3.

(a) Write down the equation of a straight line that is parallel to $y = 5x + 6$

.....

(1)

(b) Find an equation of the line that is perpendicular to the line $y = 5x + 6$ and passes through the point (–2, 5).

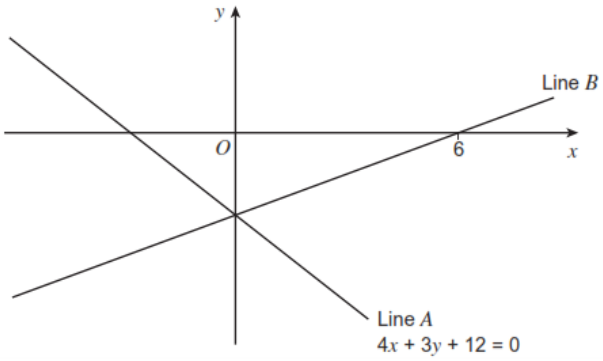
.....

(3)
(Total 4 marks)

Q4. Lines, A and B, intersect on the y-axis.

Line B intersects the x-axis at the point (6, 0).

The equation of line A is $4x + 3y + 12 = 0$



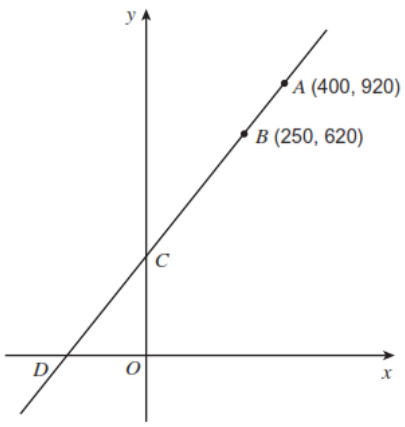
Work out the equation of line B.

Answer .....

(Total 4 marks)

Q5. The diagram shows a line $ABCD$.
A is the point (400, 920).
B is the point (250, 620).
The line cuts the y-axis at C and the x-axis at D.

Not drawn accurately



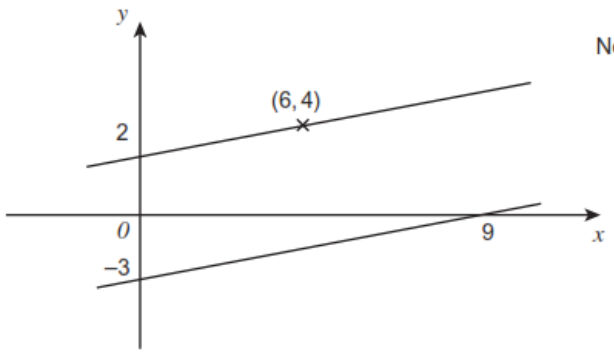
Work out the coordinates of C and D.

C (..... , ...)

D (..... , ...)

(Total 4 marks)

Q6. Two straight lines are shown.



Not drawn accurately

Prove that the lines never meet.

(Total 3 marks)

Q7.

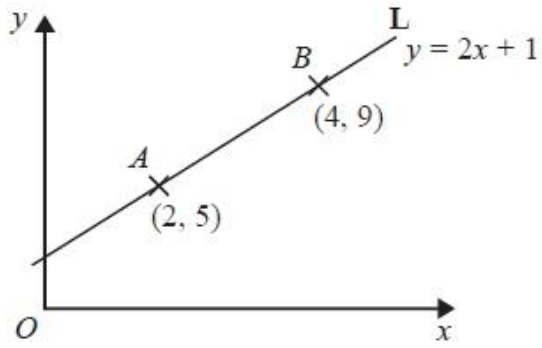


Diagram **NOT** accurately drawn

The point *A* has coordinates (2, 5).
The point *B* has coordinates (4, 9).

The line **L** passes through the points *A* and *B*.
The equation of line **L** is $y = 2x + 1$

M is the midpoint of the line segment *AB*.

Find an equation of the line that is perpendicular to line **L** and passes through *M*.

(Total 4 marks)

***Q8.** *A* is the point with coordinates (1, 3)
B is the point with coordinates (4, −1)
The straight line *L* goes through both *A* and *B*.

Is the line with equation $2y = 3x - 4$ perpendicular to line *L*?
You must show how you got your answer.

(Total 4 marks)

Q9.

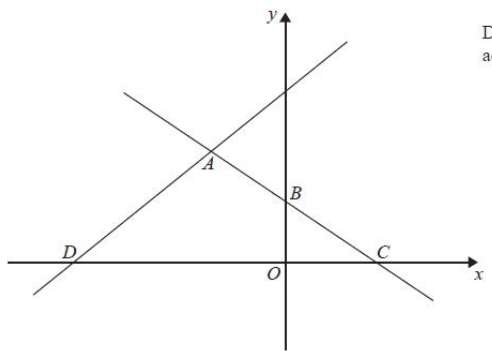


Diagram **NOT** accurately drawn

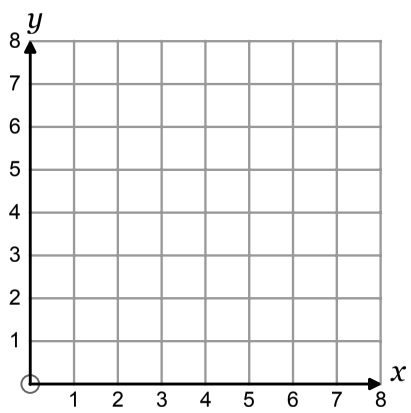
In the diagram, *ABC* is the line with equation $y = -\frac{1}{2}x + 5$

AB = *BC*
D is the point with coordinates (−13, 0)

Find an equation of the line through *A* and *D*.

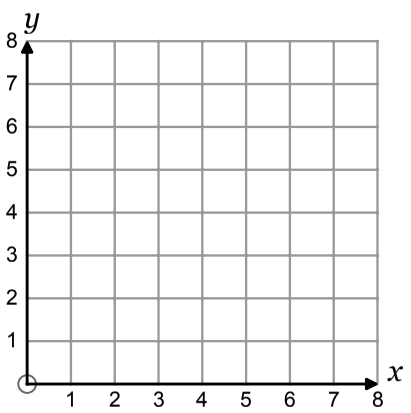
4 Graphical Inequalities

1.



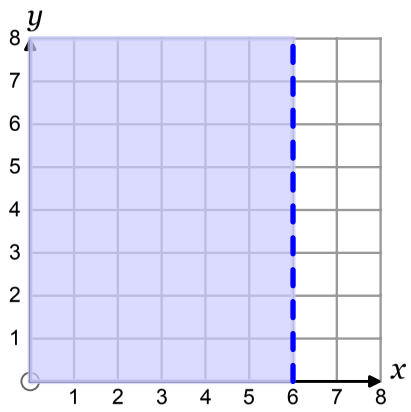
Shade the region: $x \geq 3$.

2.



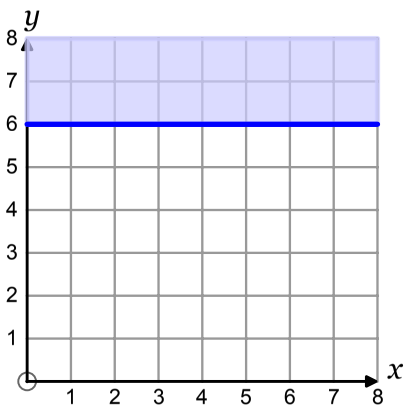
Shade the region: $y < 5$.

3.



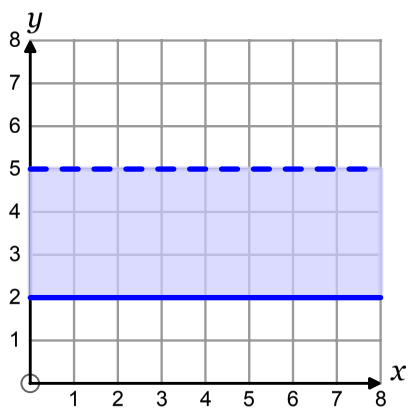
State the inequality: _____

4.



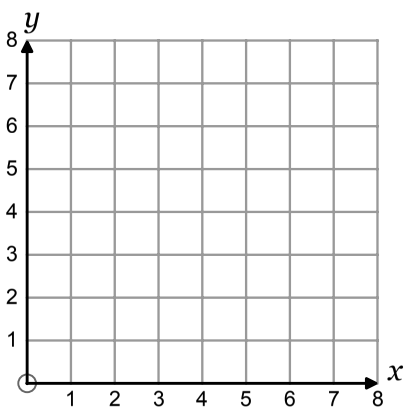
State the inequality: _____

5.



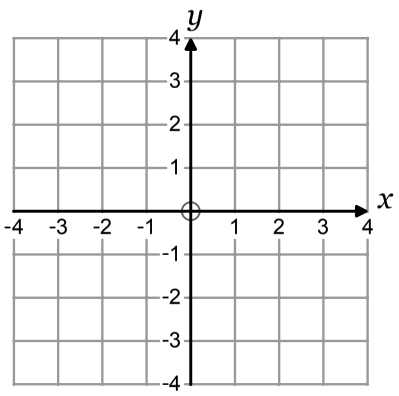
State the inequality: _____

6.



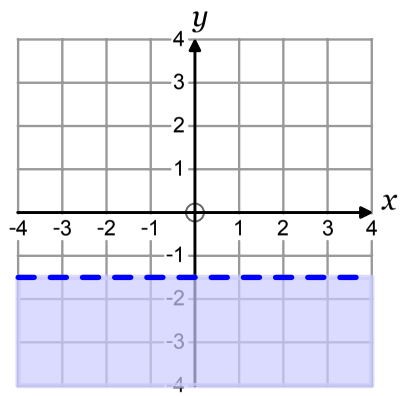
Shade the region: $1 < x < 4$.

7.



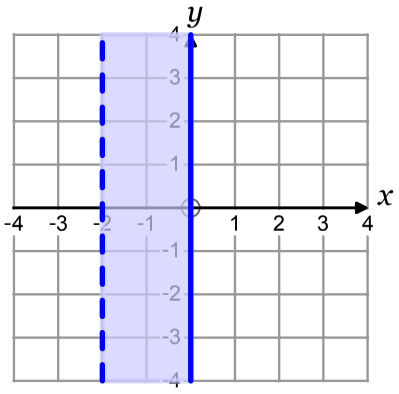
Shade the region: $y > -1$.

8.



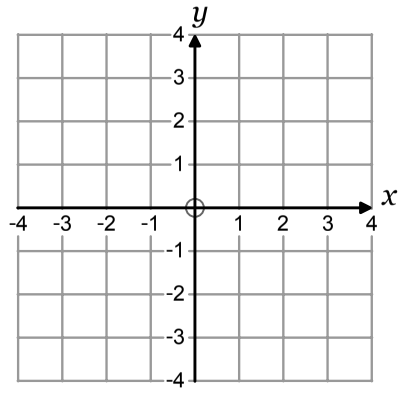
State the inequality: _____

9.



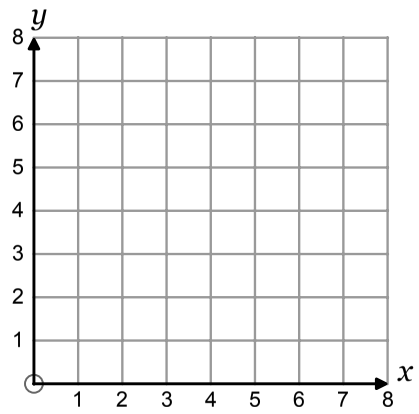
State the inequality: _____

10.



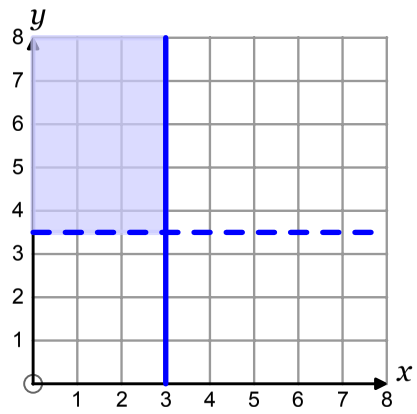
Shade the region: $-3 \leq y \leq -1$.

11.



Shade the region of points that satisfy **both**: $2 < x < 7$ **and** $2 < y < 5$.

12.

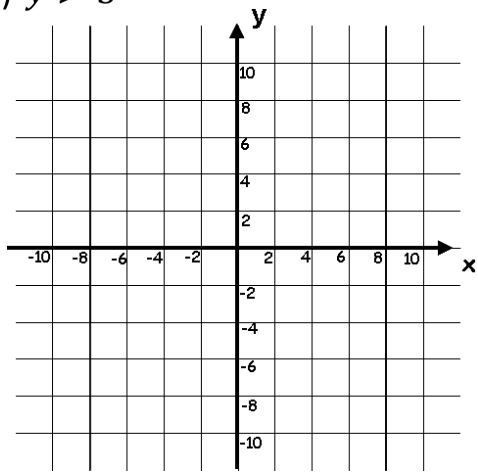


State two inequalites to describe the shaded region:

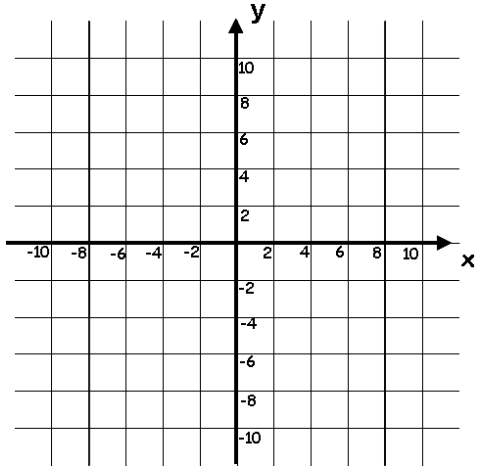
_____ ***and*** _____

Show the regions that satisfy the inequality(ies) given on the set of axes.

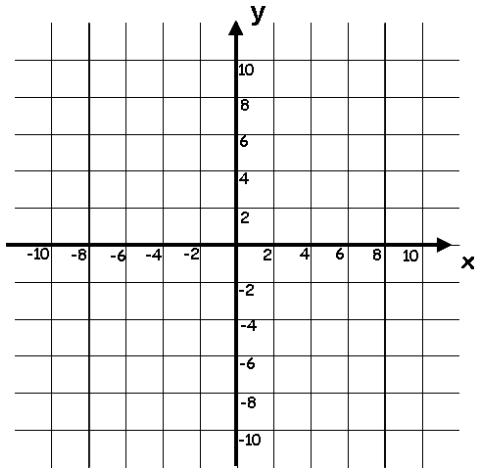
a) $y > 3$



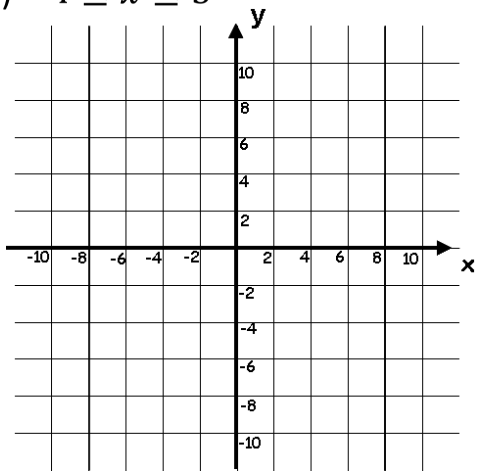
b) $x \leq -4$



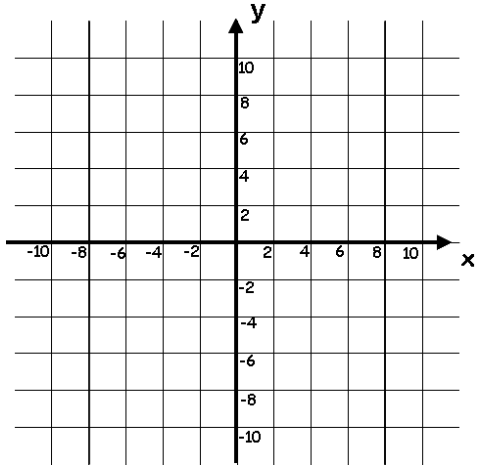
c) $y > 2$ *and* $x < 0$



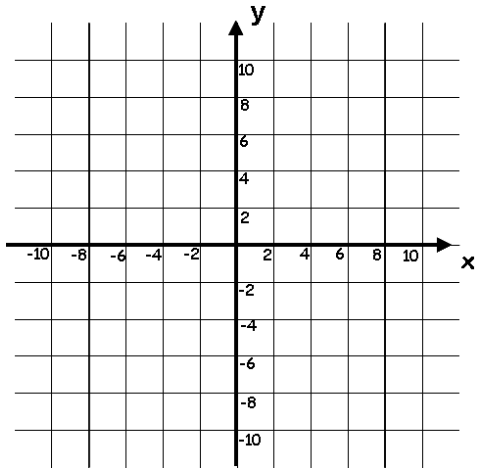
d) $-4 \leq x \leq 5$



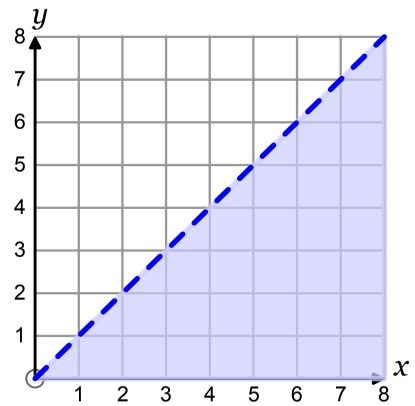
e) $-6 < y \leq 2$



f) $-4 \leq x < 4$ and $-2 < y < 8$

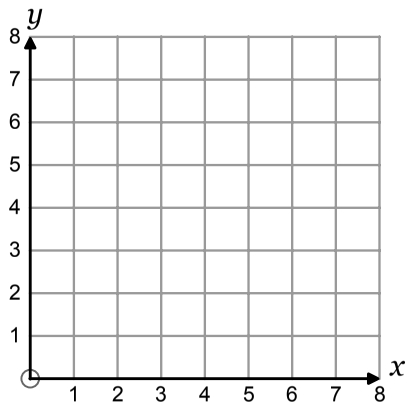


1.



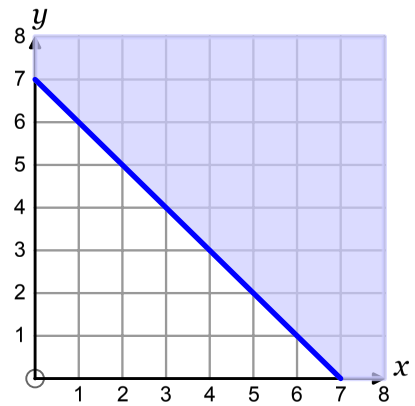
State the inequality: _____

2.



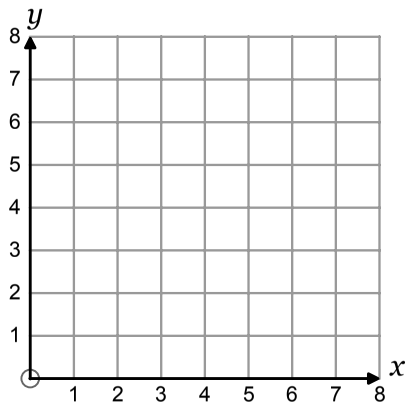
Shade the region: $y \geq x + 2$.

3.



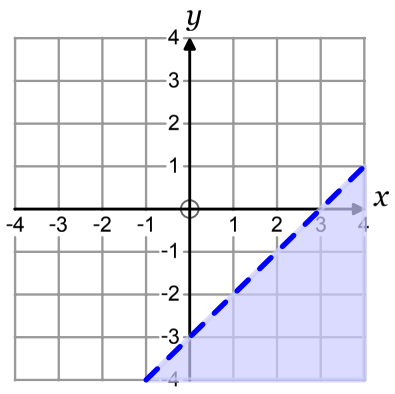
State the inequality: _____

4.



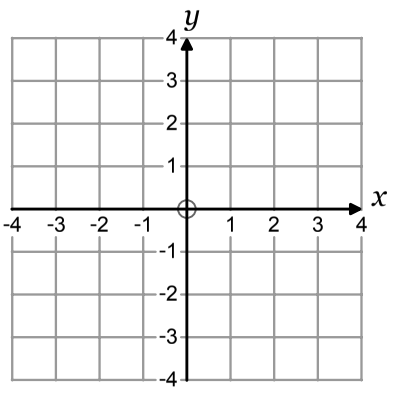
Shade the region: $y > 2x + 2$.

5.



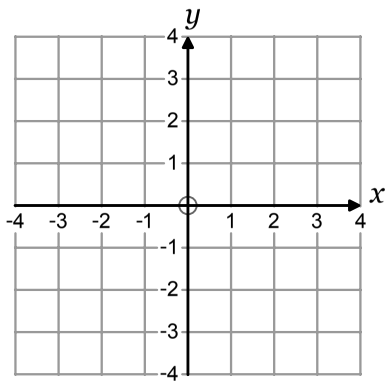
State the inequality: _____

6.



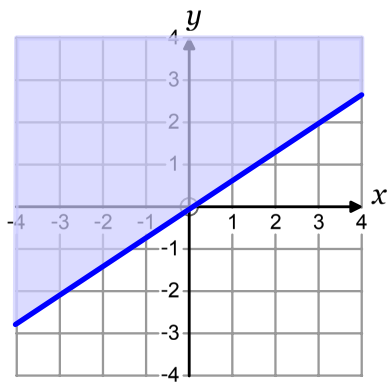
Shade the region: $y \geq \frac{1}{2}x$.

7.



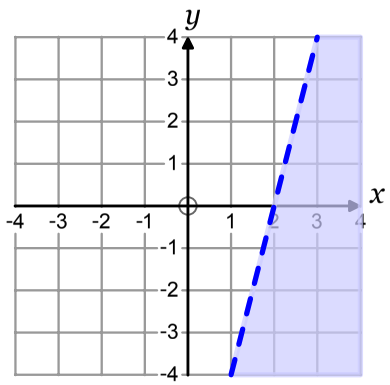
Shade the region: $y < -3x - 2$.

8.



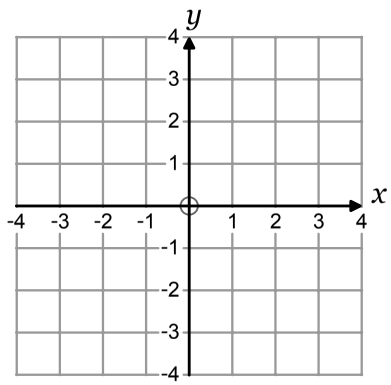
State the inequality: _____

9.



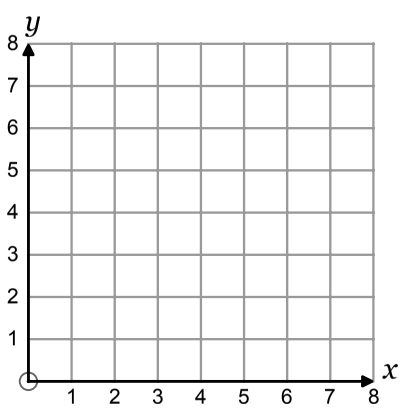
State the inequality: _____

10.



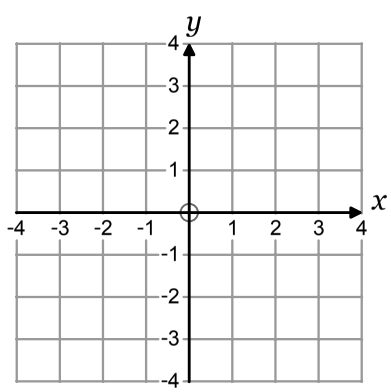
Shade the region: $x + y \leq 3$.

11.



Shade the region: $2x + 6y > 12$

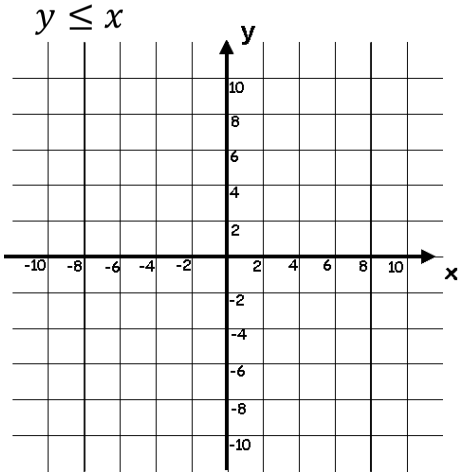
12.



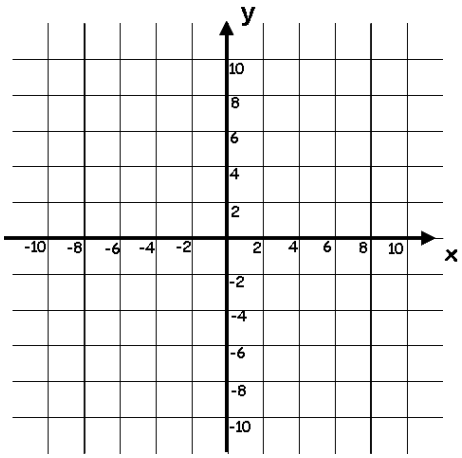
Shade the region: $2x - 3y \leq 6$

Show the regions that satisfy the inequality(ies) given on the set of axes.

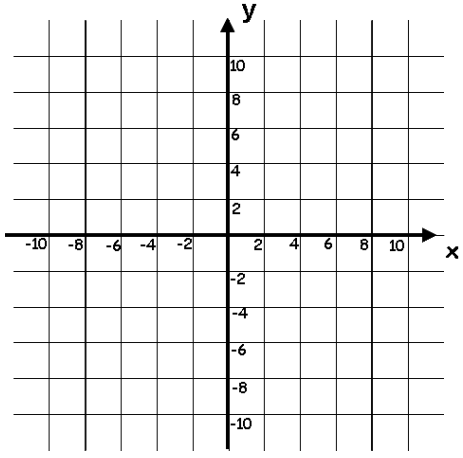
a) $y \leq x$



b) $y > x \text{ and } x \geq 5$



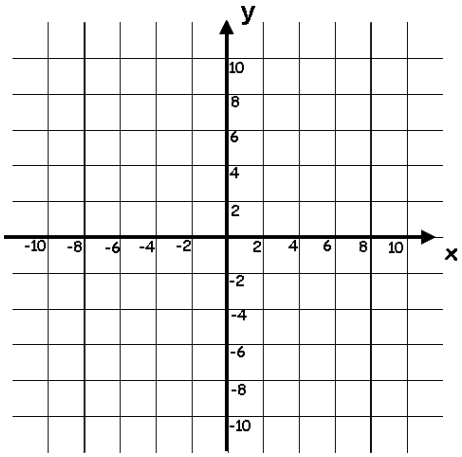
c) $y < x, y > 2 \text{ and } x < 6$



d) $y \geq x - 2 \text{ and } y < x + 1$

x	0	1	2
y			

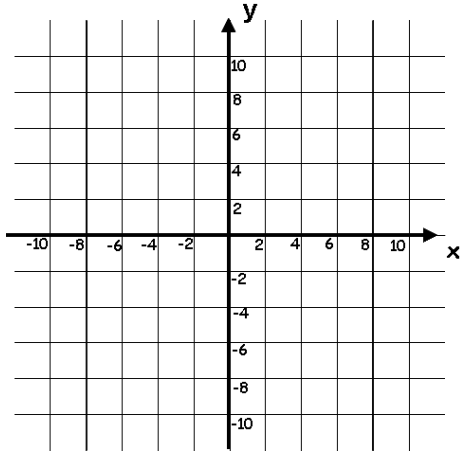
x	0	1	2
y			



e) $y > 2x \text{ and } y > \frac{1}{2}x$

x	0	1	2
y			

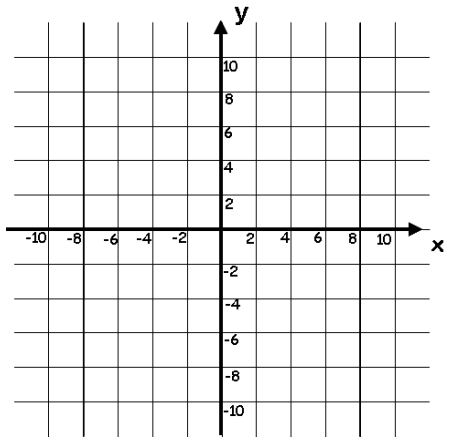
x	0	1	2
y			



f) $y > 3x \text{ and } y < 2 - x$

x	0	1	2
y			

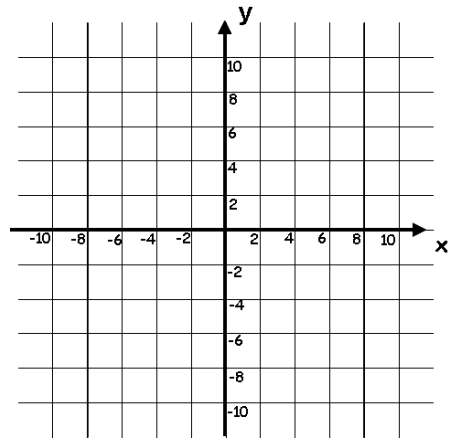
x	0	1	2
y			



h) $y \geq 2x + 1 \text{ and } y < x + 1$

x	0	1	2
y			

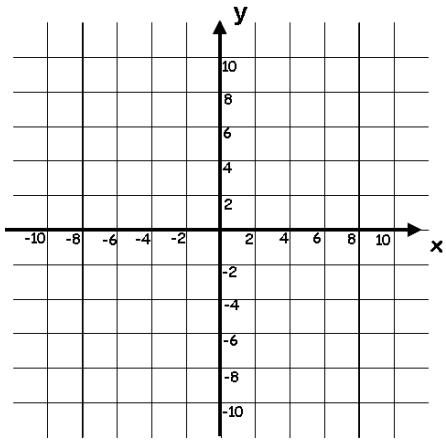
x	0	1	2
y			



g) $y \geq x - 4 \text{ and } y < 4 - 2x$

x	0	1	2
y			

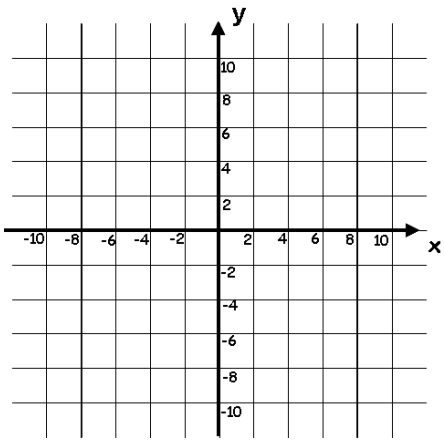
x	0	1	2
y			



i) $y > 4x + 1 \text{and } y > -2 - x$

x	0	1	2
y			

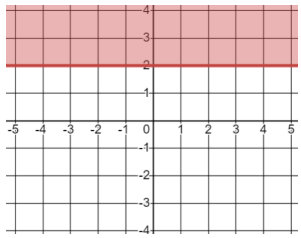
x	0	1	2
y			



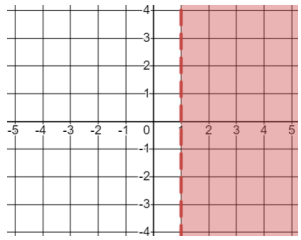
Describing Graphical Inequalities

Write down the inequality or inequalities that define the shaded region.

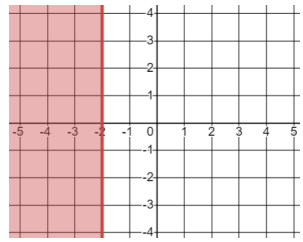
(a)



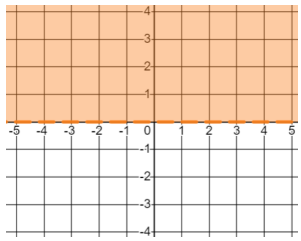
(b)



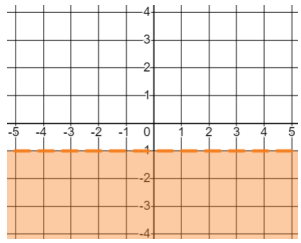
(c)



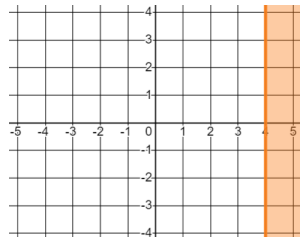
(d)



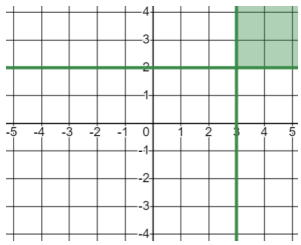
(e)



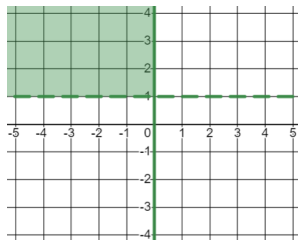
(f)



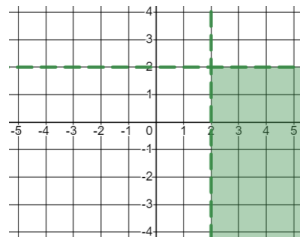
(g)



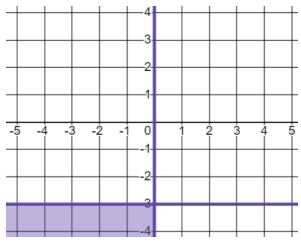
(h)



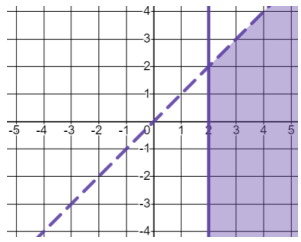
(i)



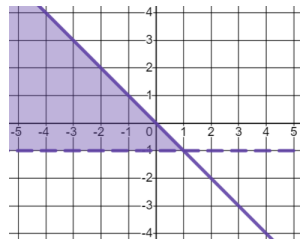
(j)



(k)



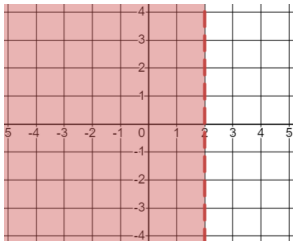
(l)



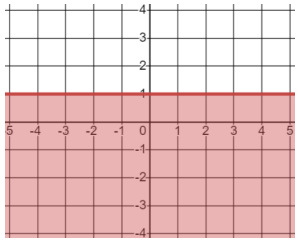
Describing Harder Graphical Inequalities

Write down the inequality or inequalities that define the shaded region.

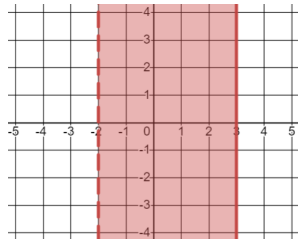
(a)



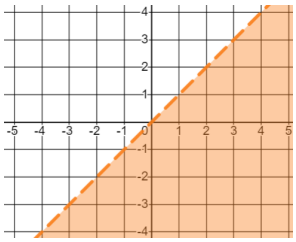
(b)



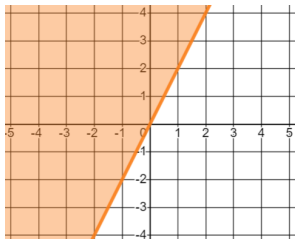
(c)



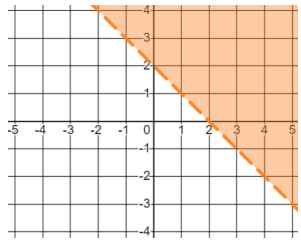
(d)



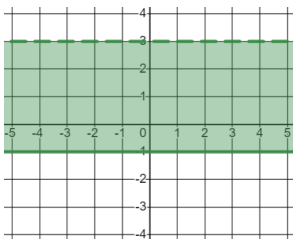
(e)



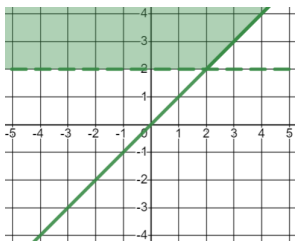
(f)



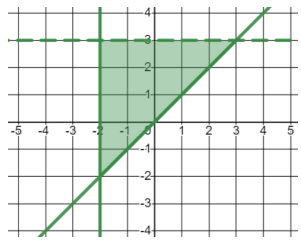
(g)



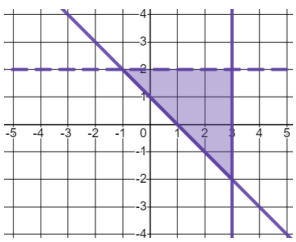
(h)



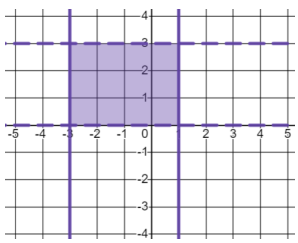
(i)



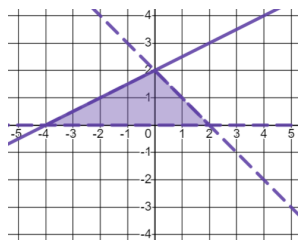
(j)



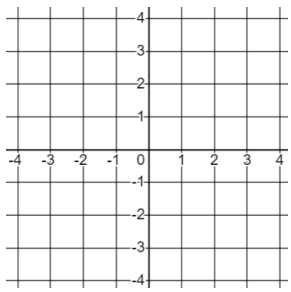
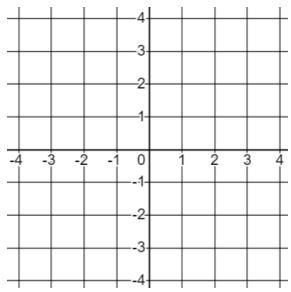
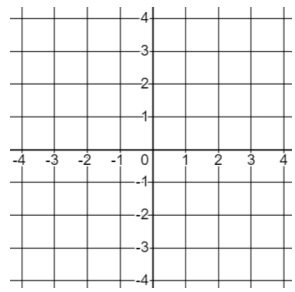
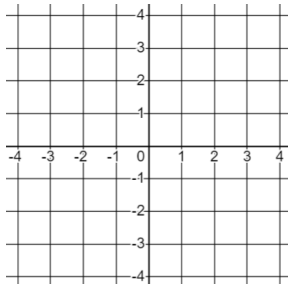
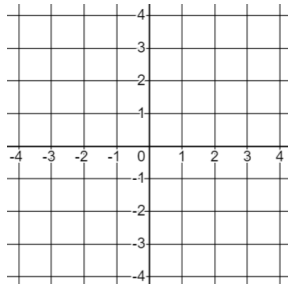
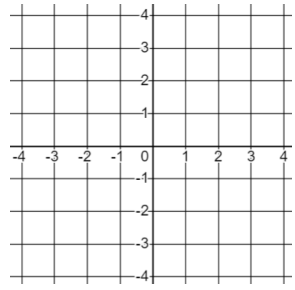
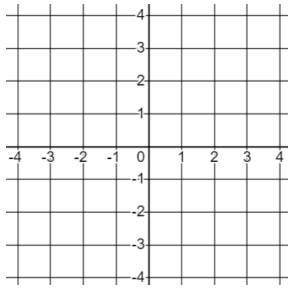
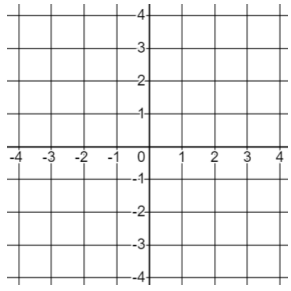
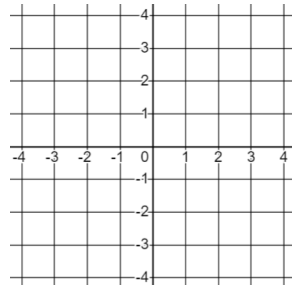
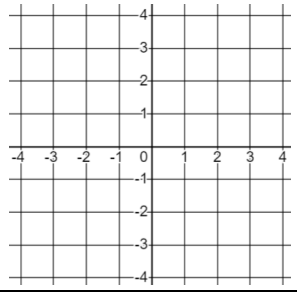
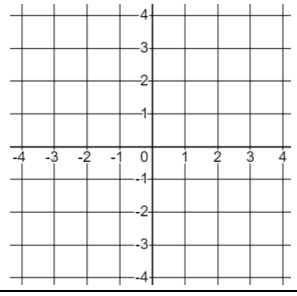
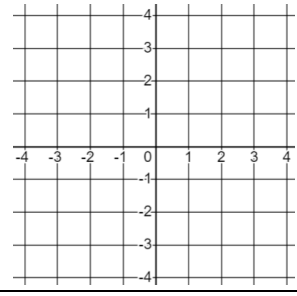
(k)



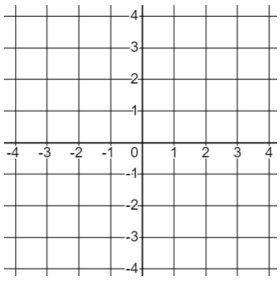
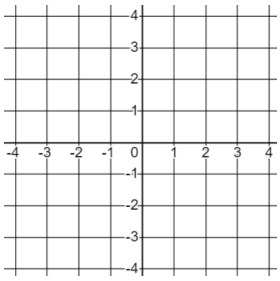
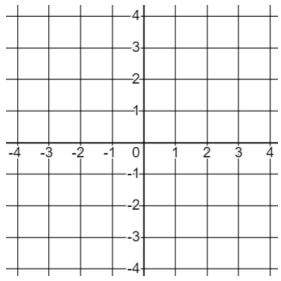
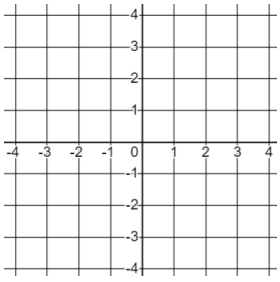
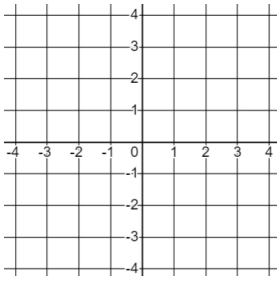
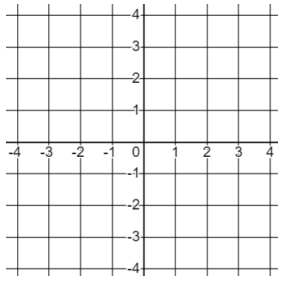
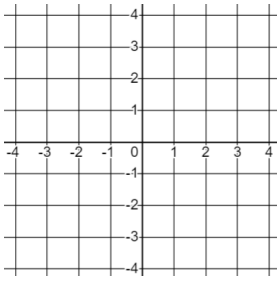
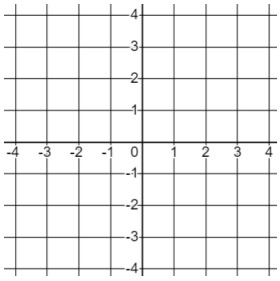
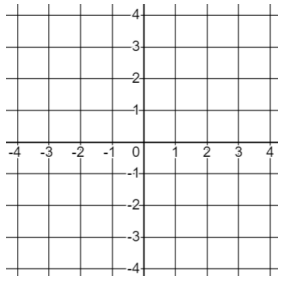
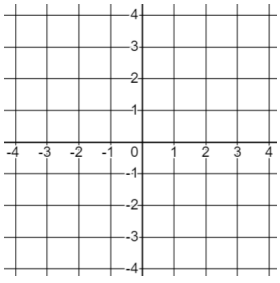
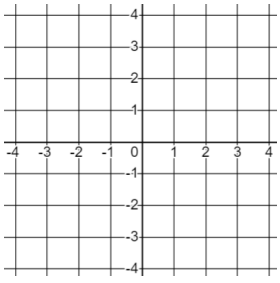
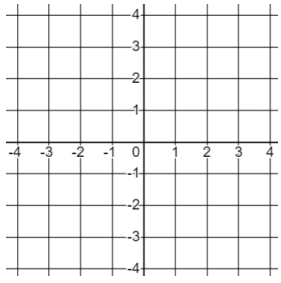
(l)



Shading Graphical Inequalities

(a)	(b)	(c)
$y > 1$ 	$y \leq -2$ 	$x < 0$ 
(d)	**(e)**	**(f)**
$x \geq 3$ 	$y \geq 0$ 	$x \leq -3$ 
(g)	**(h)**	**(i)**
$x \geq 2$ *and* $y < 1$ 	$x < -1$ *and* $y > 3$ 	$x \leq 0$ *and* $y < 0$ 
(j)	**(k)**	**(l)**
$x \geq -1$ *and* $y \geq 3$ 	$y \geq x$ *and* $x < 2$ 	$y < -x$ *and* $y \leq -1$ 

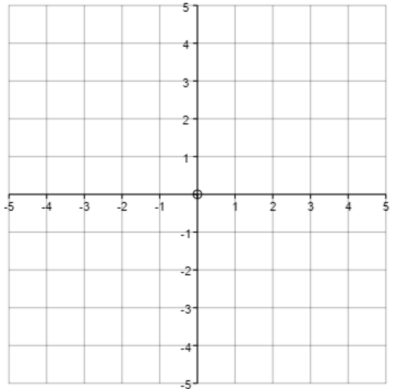
Shading Harder Graphical Inequalities

(a)	(b)	(c)
$y \geq -1$ 	$x < 2$ 	$y > x$ 
(d)	**(e)**	**(f)**
$y \geq 0.5x - 1$ 	$x + y \leq 3$ 	$-3 \leq y < 2$ 
(g)	**(h)**	**(i)**
$-2 \leq x < 3$ 	$x \geq 0 \text{ and } y < x$ 	$x \geq -1, y > 0 \text{ and } x + y < 2$ 
(j)	**(k)**	**(l)**
$2 < x < 4 \text{ and } -1 \leq y \leq 1$ 	$y < 2x, x + y \leq 4 \text{ and } y > 0$ 	$y < x, y \geq -2 \text{ and } 2x + y < 4$ 

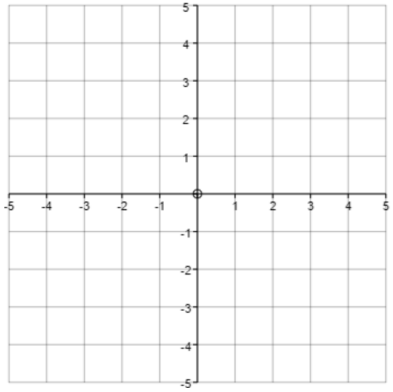
Fluency Practice

Shading and Describing Harder Graphical Inequalities

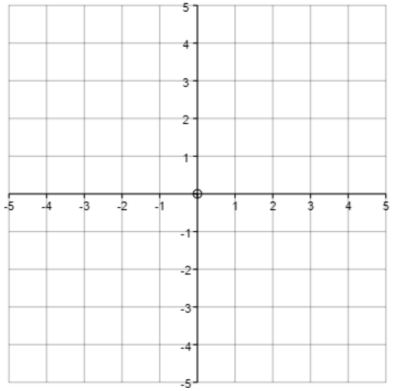
Shade the region that satisfies the inequalities $x \leq 4 \quad y \geq -1 \quad y \leq x$



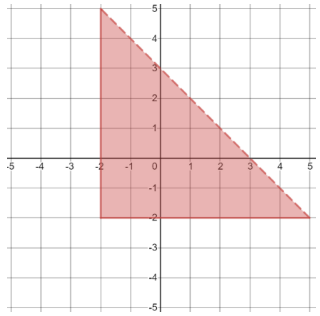
Shade the region that satisfies the inequalities $x > -1 \quad y \geq 0 \quad x + y \leq 3$



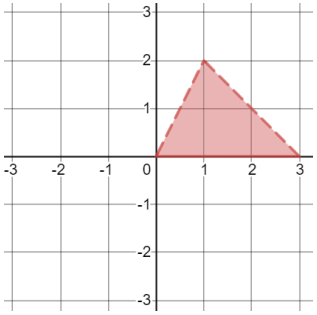
Shade the region that satisfies the inequalities $2x + 3y < 6 \quad y \leq x + 2 \quad y > -1$



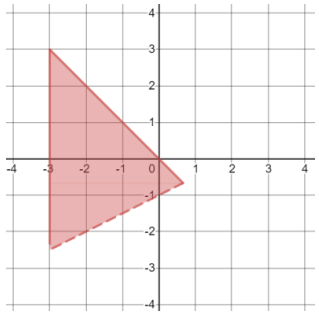
Write down the inequalities which fully describe the shaded region.



Write down the inequalities which fully describe the shaded region.



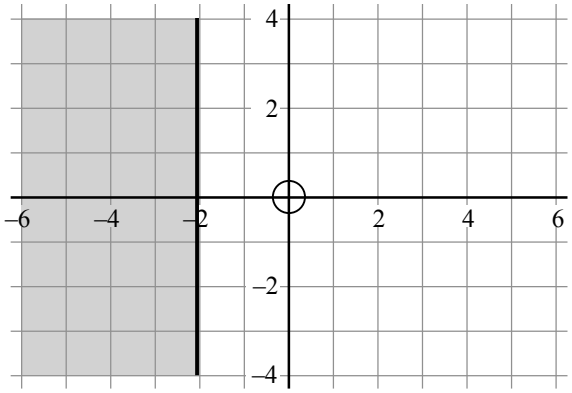
Write down the inequalities which fully describe the shaded region.



Fluency Practice

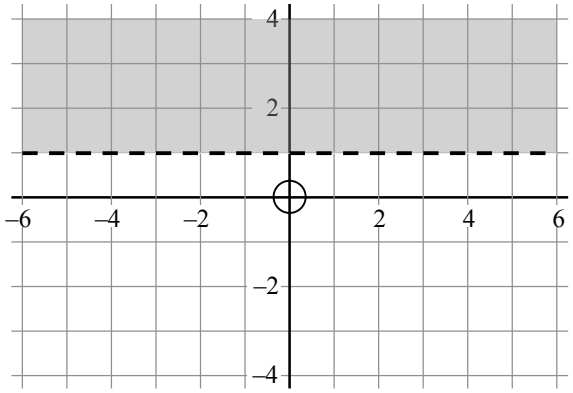
A1

Write down the inequality which defines the unshaded region.



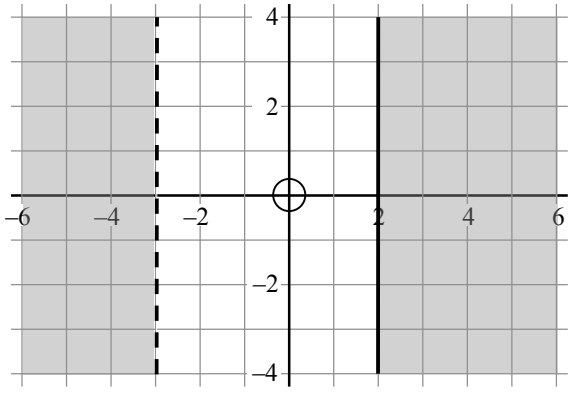
A2

Write down the inequality which defines the unshaded region.



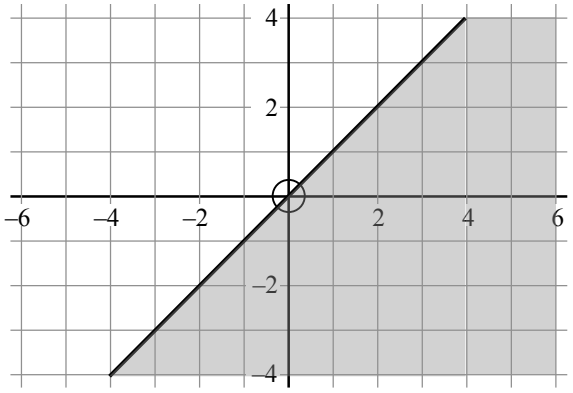
A3

Write down the inequalities which define the unshaded region.



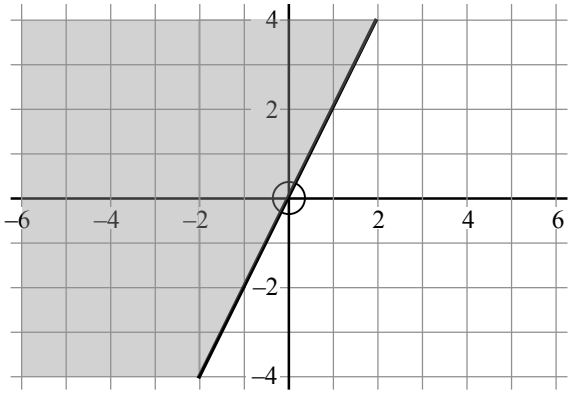
B1

Write down the inequality which defines the unshaded region.



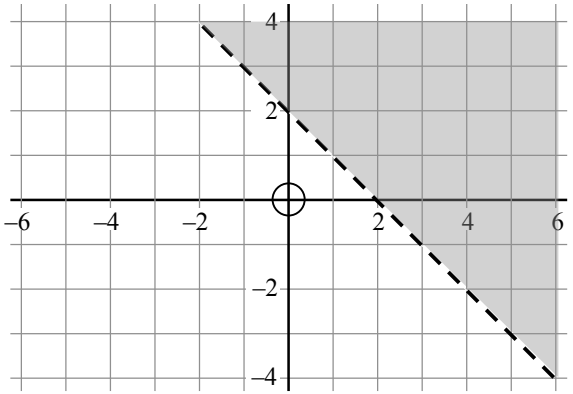
B2

Write down the inequality which defines the unshaded region.



B3

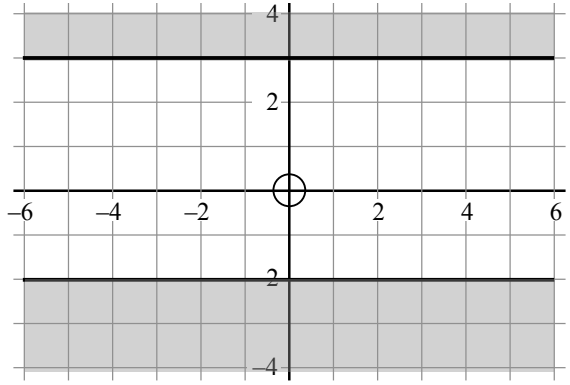
Write down the inequality which defines the unshaded region.



Fluency Practice

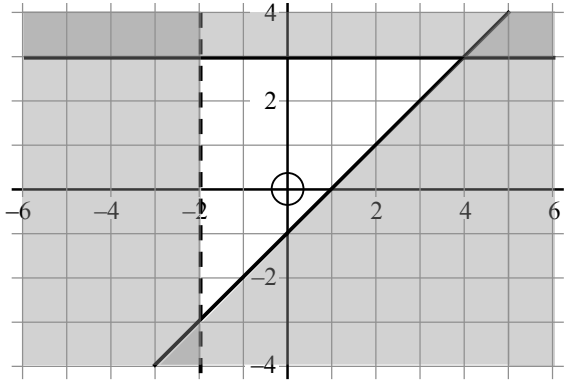
A1

Write down the inequalities which fully define the unshaded region.



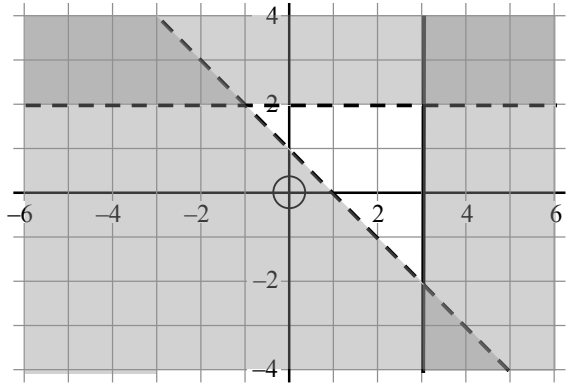
A2

Write down the inequalities which fully define the unshaded region.



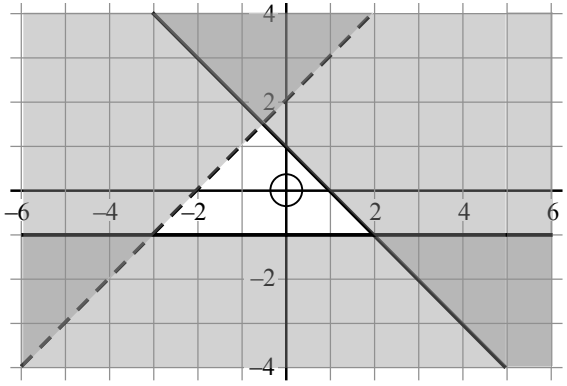
A3

Write down the inequalities which fully define the unshaded region.



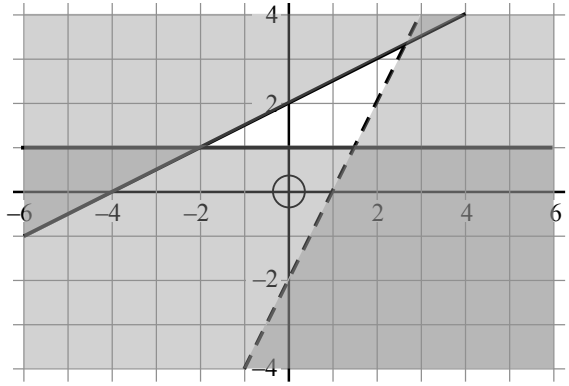
B1

Write down the inequalities which fully define the unshaded region.



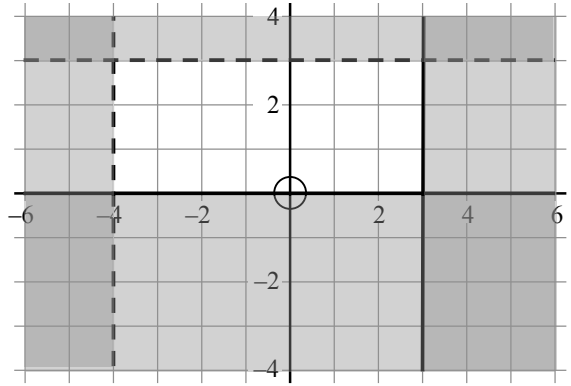
B2

Write down the inequalities which fully define the unshaded region.



B3

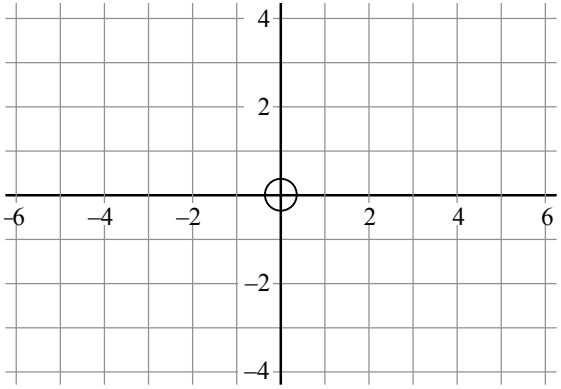
Write down the inequalities which fully define the unshaded region.



Fluency Practice

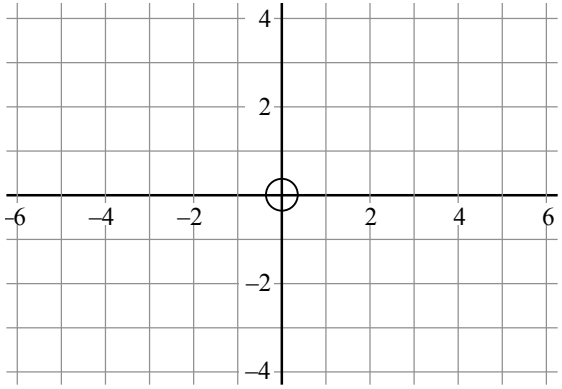
A1 Show, by shading on the grid, the region defined by $y \geq -1$

Label your region **R**.



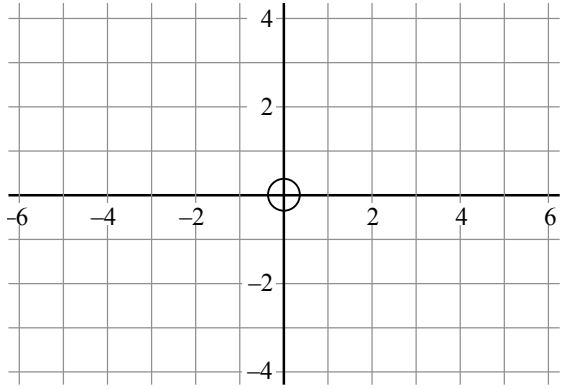
A2 Show, by shading on the grid, the region defined by $x < 3$

Label your region **R**.



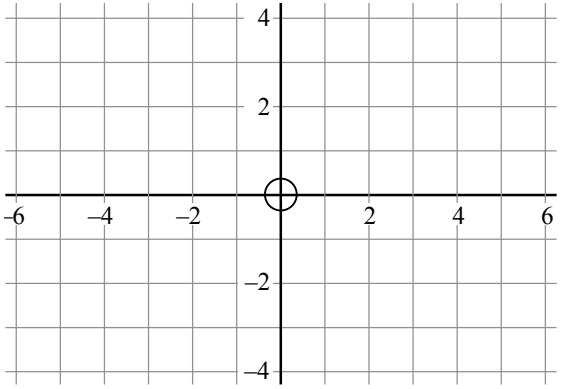
A3 Show, by shading on the grid, the region defined by $y < x$

Label your region **R**.



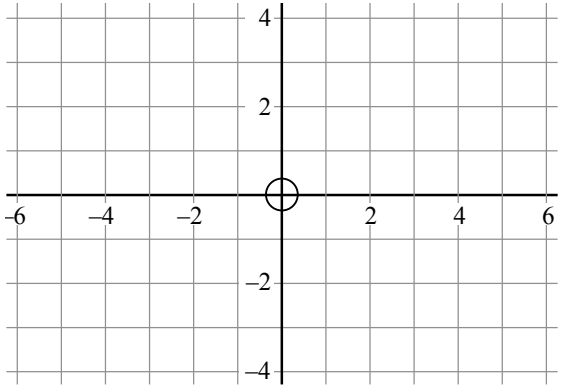
B1 Show, by shading on the grid, the region defined by $y \geq 0.5x - 1$

Label your region **R**.



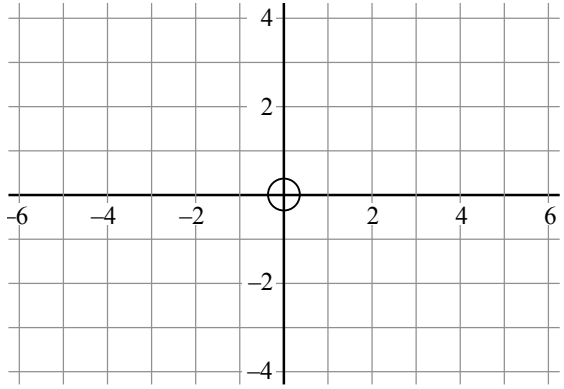
B2 Show, by shading on the grid, the region defined by $x + y \leq 3$

Label your region **R**.



B3 Show, by shading on the grid, the region defined by $-3 \leq y < 2$

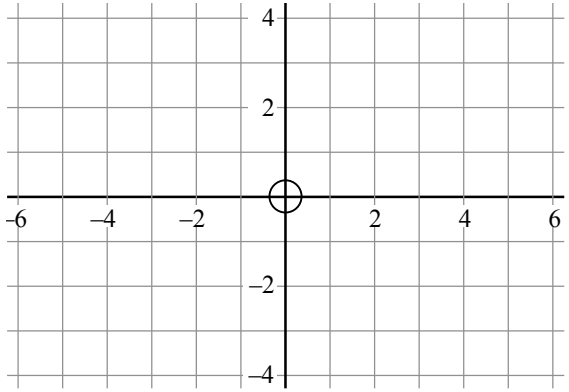
Label your region **R**.



Fluency Practice

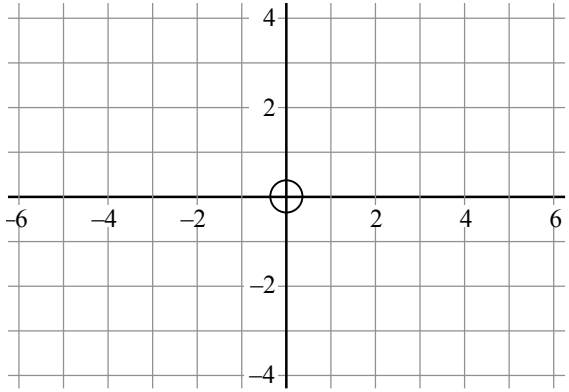
A1 Show, by shading on the grid, the region defined by $-4 \leq x \leq 3$

Label your region **R**.



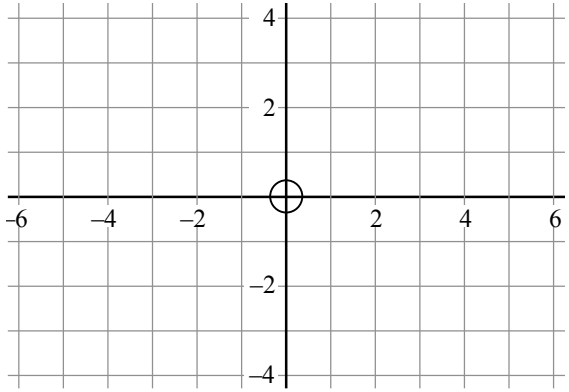
A2 Show by shading on the grid the region defined by $x \geq -3$, $y < 2$ **and** $y > x$

Label your region **R**.



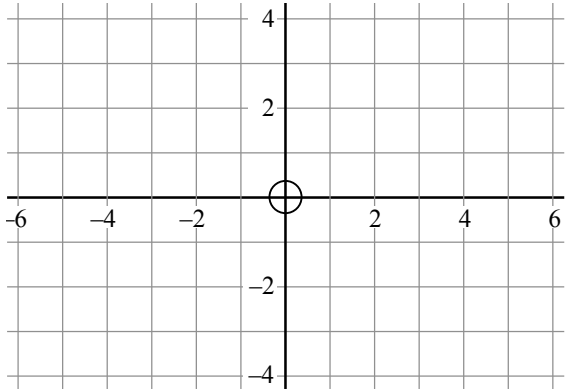
A3 Show by shading on the grid the region defined by $x + y \leq -1$, $x \geq -4$ **and** $y \geq -3$

Label your region **R**.



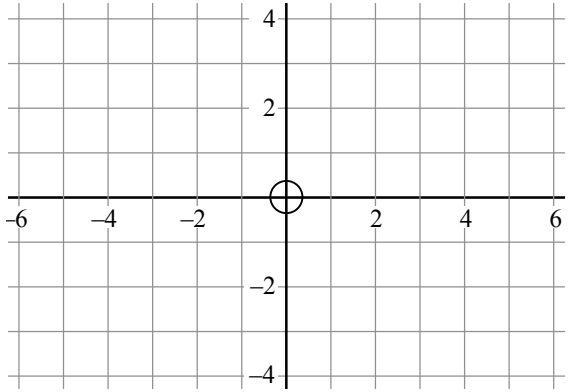
B1 Show by shading on the grid the region defined by $-2 < y \leq 3$ **and** $-3 \leq x < 5$

Label your region **R**.



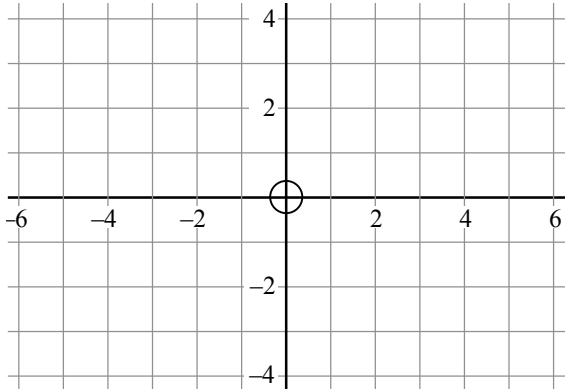
B2 Mark with a cross (x) a point on the grid which satisfies both the inequalities

$x > 1$ **and** $x - 3y > 3$



B3 Show by shading on the grid the region defined by $y > x + 3$, $x \geq -3$ **and** $2y - x \leq 4$

Label your region **R**.



Fluency Practice

linear inequalities: regions

(1) $y \leq 2x + 3$

$x \leq 3$

$y \geq 5$

(2) $x + 2y \geq 8$

$x \leq 6$

$y \leq 3$

(3) $x + y \geq 9$

$x \leq 4$

$y \leq x + 5$

(4) $y \geq 2x - 3$

$y \geq 3$

$y \leq x + 2$

(5) $y \leq \frac{1}{3}x + 6$

$y \geq x$

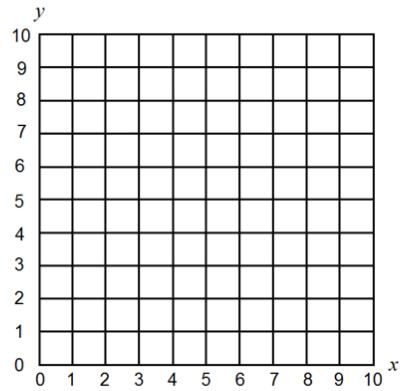
$y \geq 7$

(6) $x + 2y \geq 8$

$x \leq 6$

$2y \leq 3x - 8$

find each of these regions on a 10 by 10 grid:



the region for all questions should be a triangle with an area of 4 squares

establish that this is the case

Fluency Practice

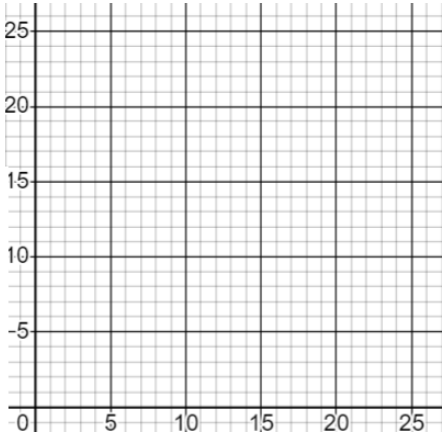
Graphical Inequalities Worded Problems

(a)

Junior's pencil case contains pens and pencils. The total number of pens and pencils is less than 25. The number of pens is greater than 5. The number of pencils is between 4 and 16.

(a) By letting x represent the number of pens and y the number of pencils, write inequalities to represent this problem.

(b) Represent this problem graphically, shading the region which satisfies all the inequalities.

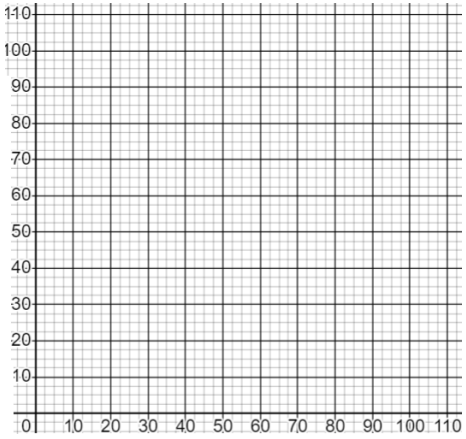


(b)

A factory manufactures beds and sofas. Each week it makes at least 30 beds and between 40 and 100 sofas. The factory always manufactures more sofas than beds.

(a) By letting x represent the number of beds and y the number of sofas, write inequalities to represent this problem.

(b) Represent this problem graphically, shading the region which satisfies all the inequalities.

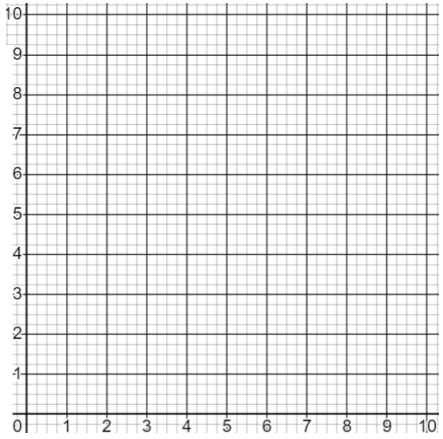


(c)

Maya is baking cakes and brownies. Each cake needs 50g of sugar and 20g of flour. Each cookie needs 30g of sugar and 50g of flour. She has 300g of sugar and 200g of flour and wants to make at least 2 cakes.

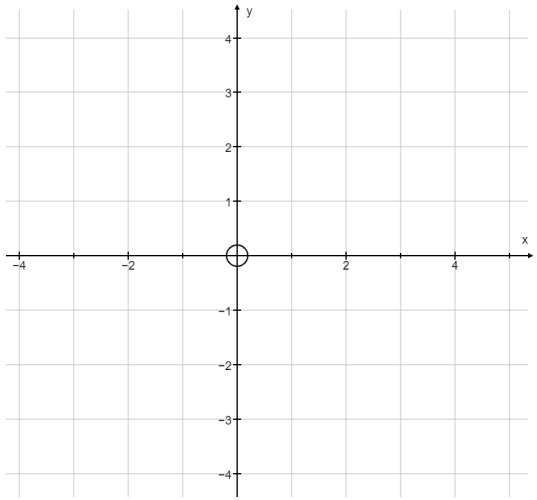
(a) By letting x represent the number of cakes and y the number of cookies, write inequalities to represent this problem.

(b) Represent this problem graphically, shading the region which satisfies all the inequalities.



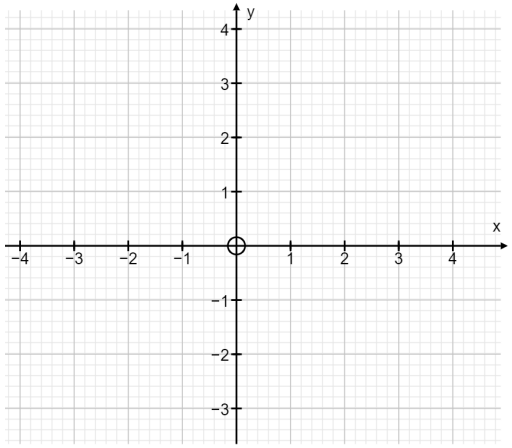
Identify the region described by the inequalities and calculate the perimeter of the region.

$$y \geq 1$$
$$x \geq 2$$
$$2y + x \leq 6$$



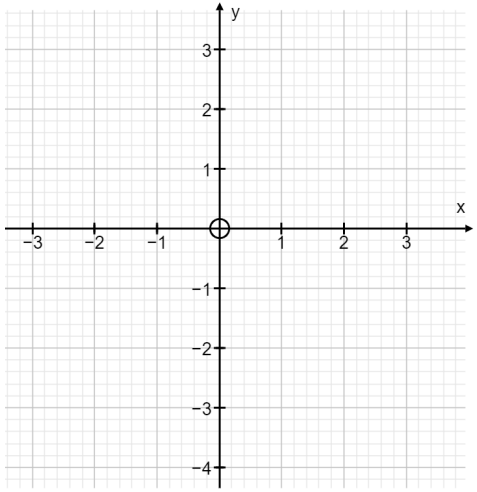
Perimeter:

$$y \geq 0$$
$$y \leq 1.5x$$
$$y \geq 3x - 9$$
$$y \leq 3$$



Perimeter:

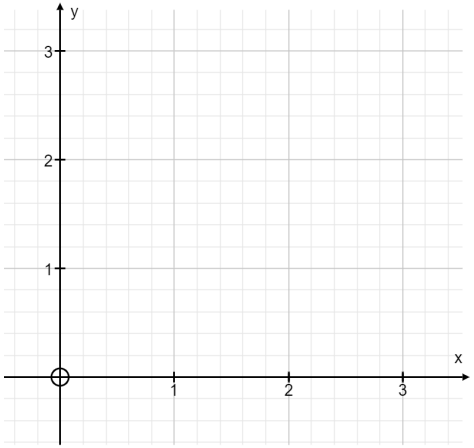
$$y \leq 4x + 11$$
$$5y + 4x \leq 7$$
$$y \geq -1$$



Perimeter:

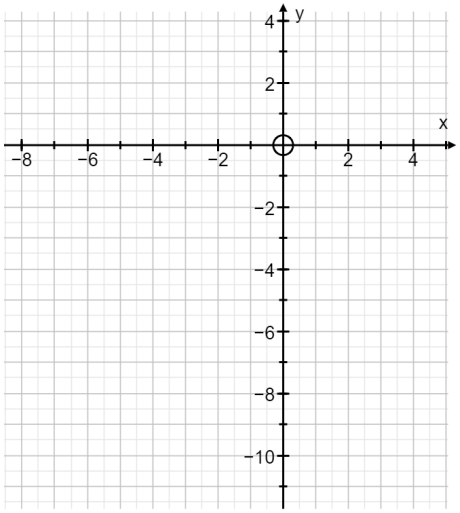
Identify the region described by the inequalities and calculate the perimeter of the region.

$$y \geq \frac{2}{3}x$$
$$y \leq 1.5x$$
$$x \leq 3$$
$$y \leq 3$$



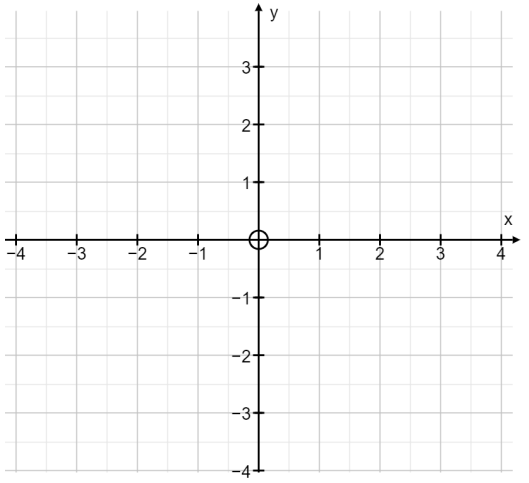
Perimeter:

$$2y + 2x \leq 7$$
$$2x - 2y \leq 7$$
$$2y - 4x \geq 7$$



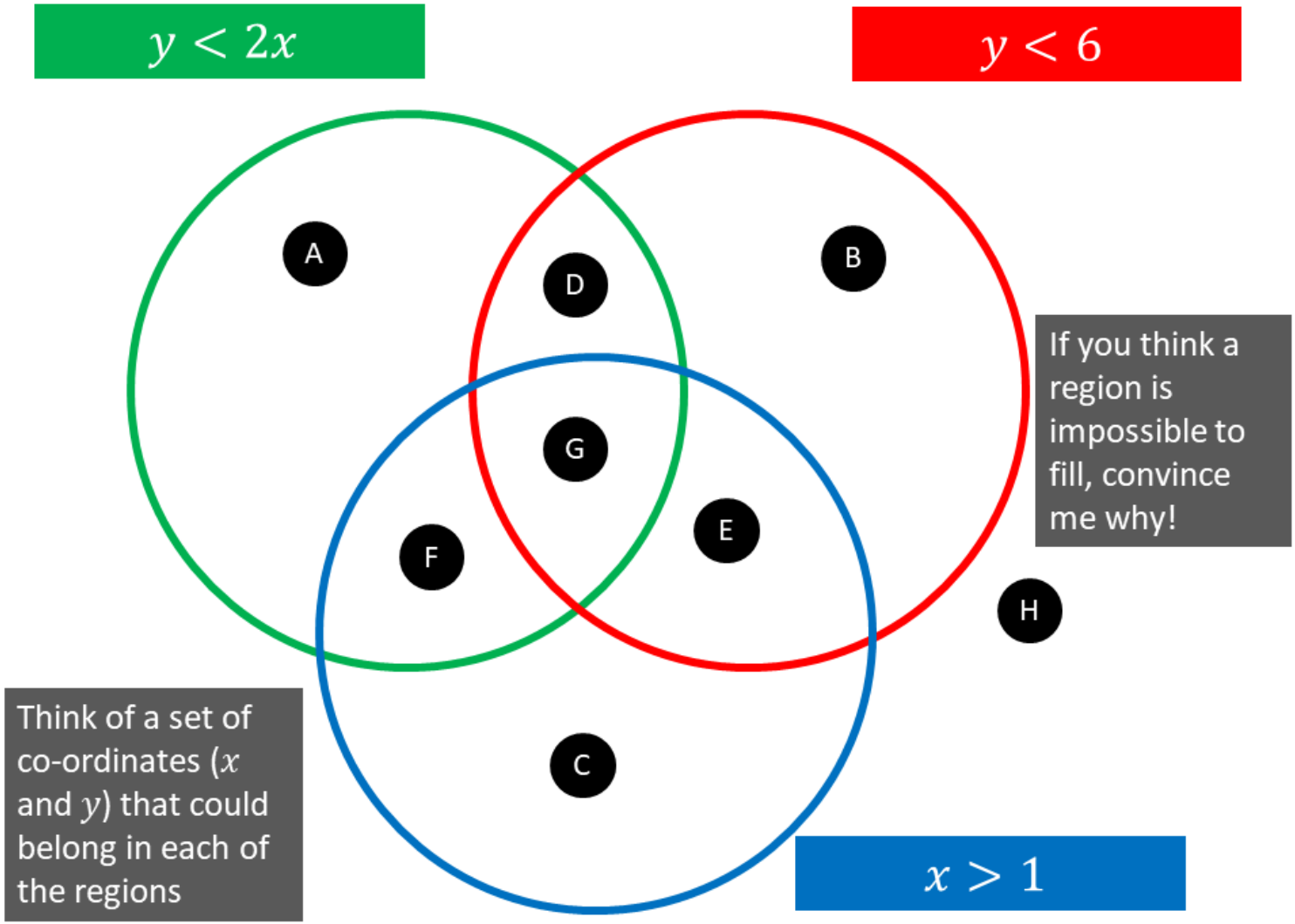
Perimeter:

$$3y + x \leq 6$$
$$4x - 3y \leq 9$$
$$3y - x \leq 6$$
$$4x + 3y \geq -9$$

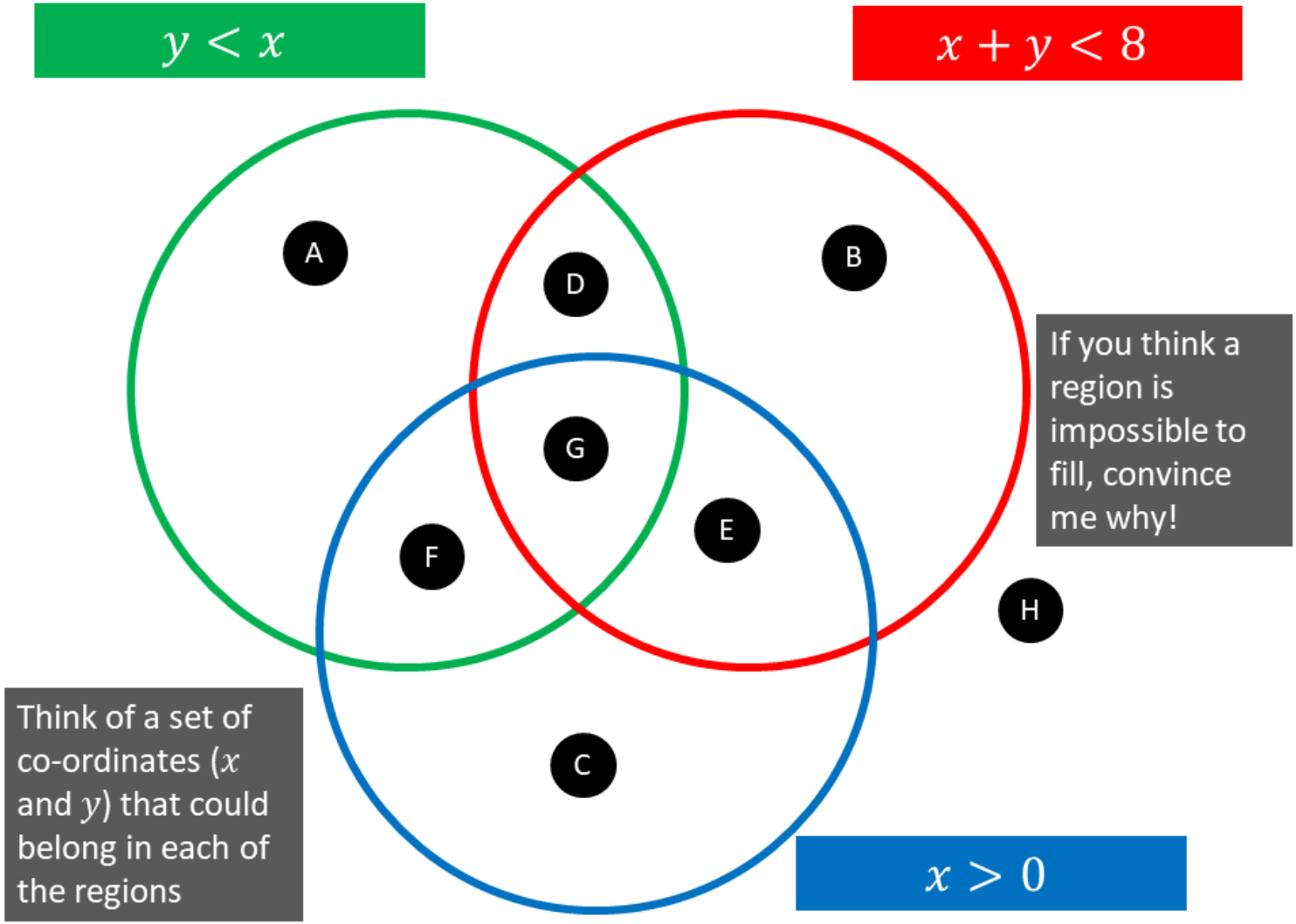


Perimeter:

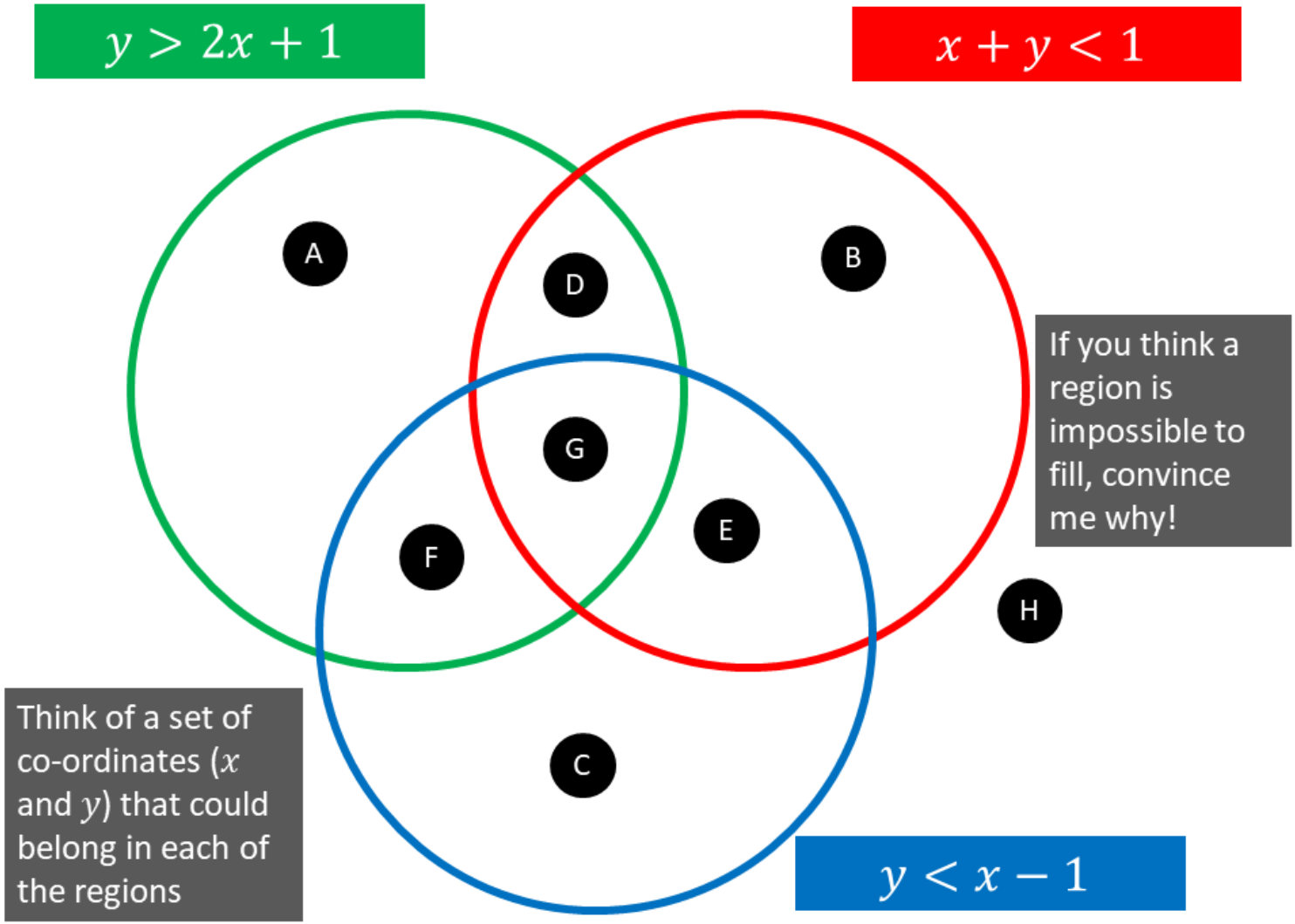
Maths Venns


$y < 2x$
$y < 6$
A
D
B
G
E
F
H
C
$x > 1$
If you think a region is impossible to fill, convince me why!
Think of a set of co-ordinates (x and y) that could belong in each of the regions

Maths Venns


$y < x$
$x + y < 8$
A
D
B
G
E
F
H
C
$x > 0$
If you think a region is impossible to fill, convince me why!
Think of a set of co-ordinates (x and y) that could belong in each of the regions

Maths Venns

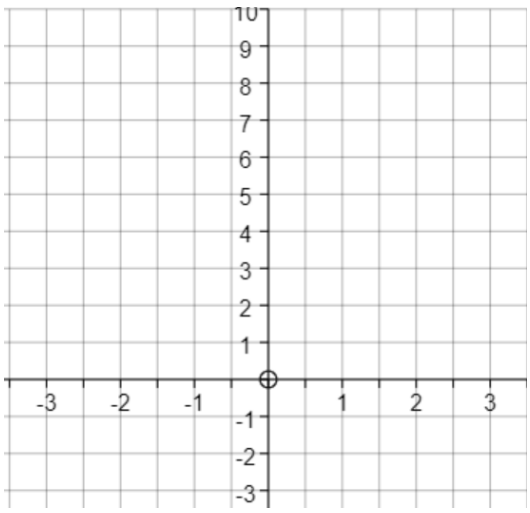

$y > 2x + 1$
$x + y < 1$
A
D
B
G
E
F
H
C
$y < x - 1$
If you think a region is impossible to fill, convince me why!
Think of a set of co-ordinates (x and y) that could belong in each of the regions

5 Non-Linear Graphs

Plotting Quadratic Graphs

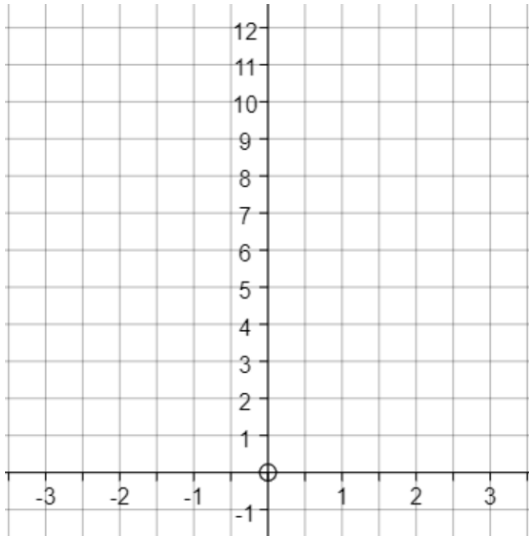
(a) $y = x^2$

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



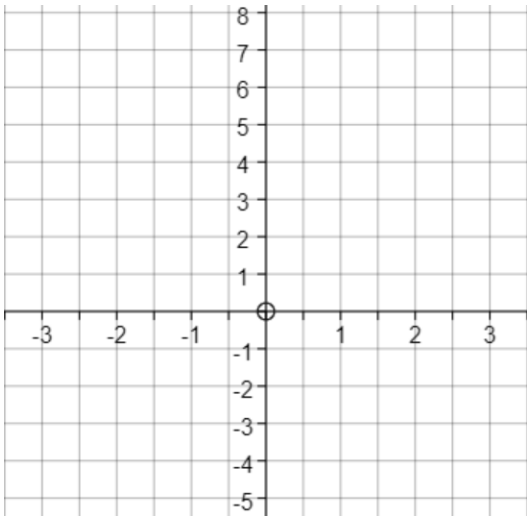
(b) $y = x^2 + 3$

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



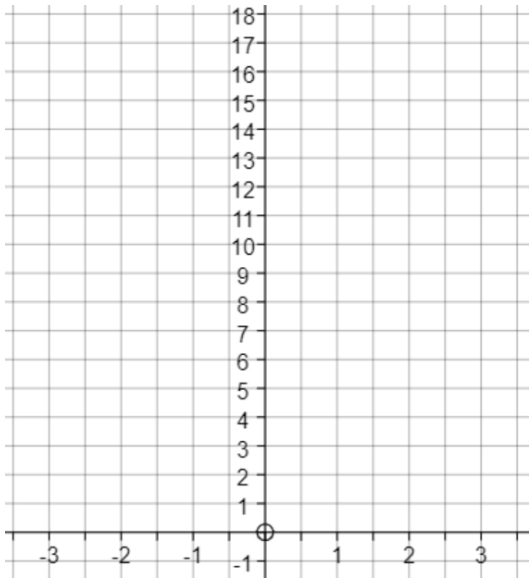
(c) $y = x^2 - 2$

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



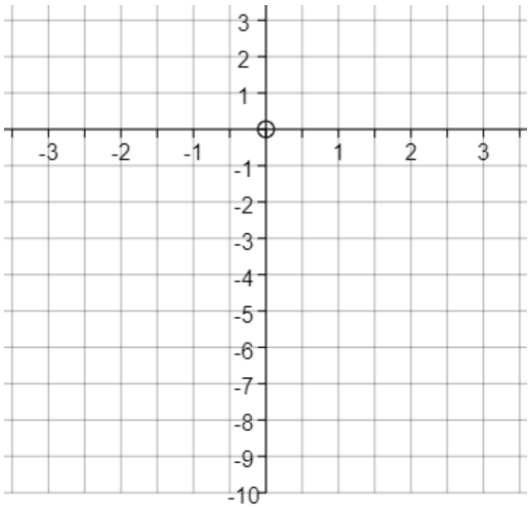
(d) $y = 2x^2$

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



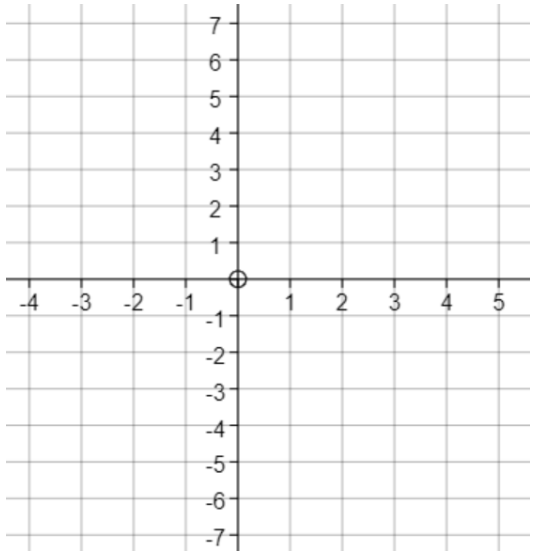
(e) $y = -x^2$

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



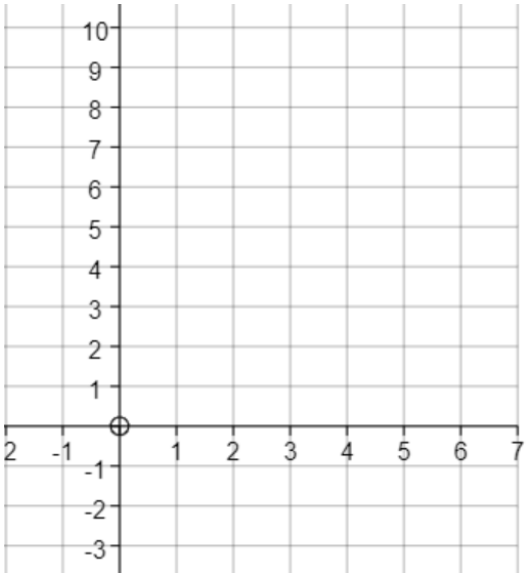
(f) $y = x^2 - x - 6$

x	-3	-2	-1	0	1	2	3	4
y								



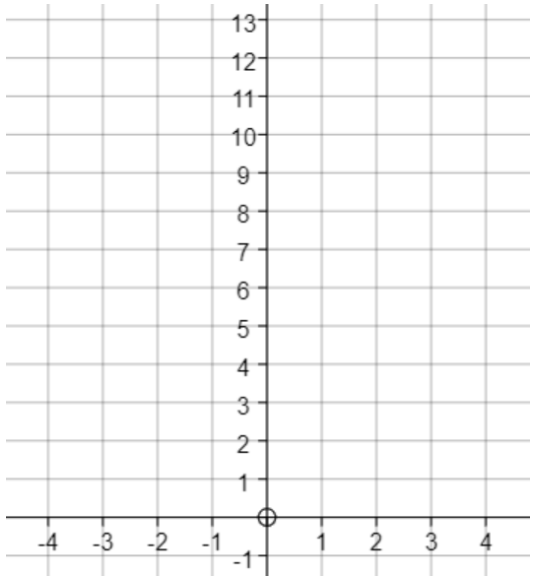
(g)

Plot the graph of $y = x^2 - 5x + 4$ for $-1 \leq x \leq 6$



(h)

Plot the graph of $y = 12 + x - x^2$ for $-3 \leq x \leq 4$

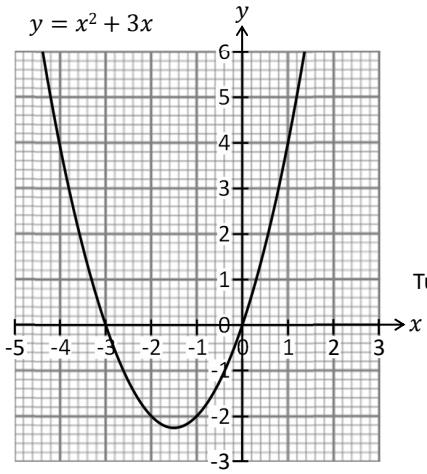


Fluency Practice

Reading the Significant Points of a Quadratic Curve

Use each graph to *estimate* each piece of information.

$y = x^2 + 3x$



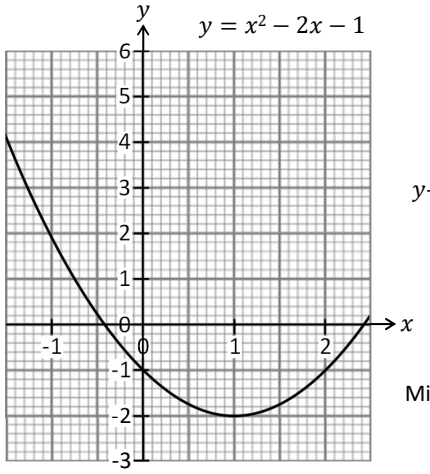
Roots: _____

y-intercept: _____

Turning Point: _____

Min or Max? _____

$y = x^2 - 2x - 1$



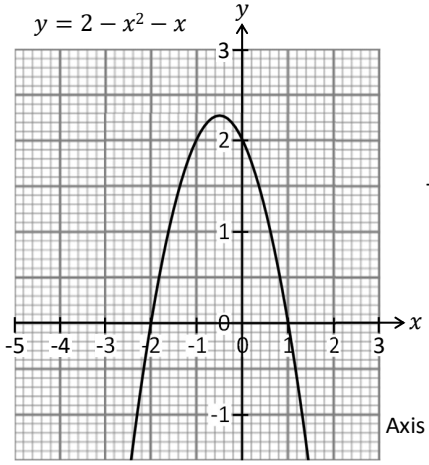
Solutions: _____

y-intercept: _____

Vertex: _____

Min or Max? _____

$y = 2 - x^2 - x$



x-intercepts: _____

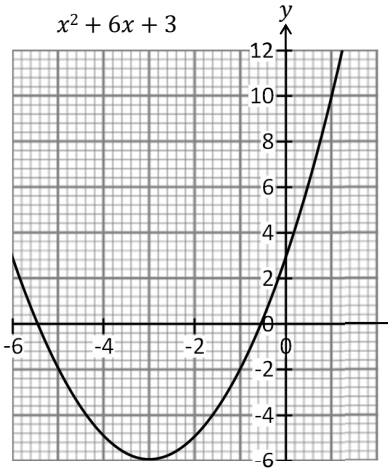
y-intercept: _____

Turning Point: _____

Min or Max? _____

Parabola's Axis of Symmetry: _____

$x^2 + 6x + 3$



Roots: _____

y-intercept: _____

Turning Point : _____

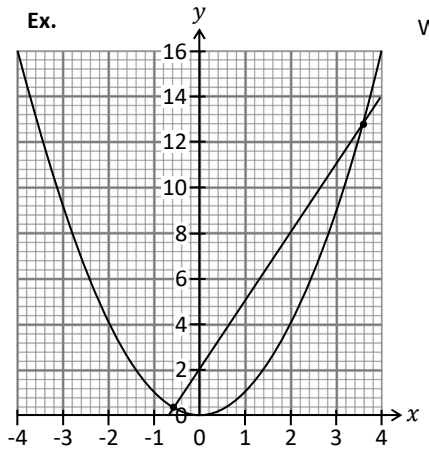
Min or Max? _____

Fluency Practice

Solving Equations using $y = x^2$

The graph $y = x^2$ has been drawn on the grid.

Ex.



We will use it to solve this equation

$x^2 - 3x - 2 = 0$

rearrange ↓

$x^2 = 3x + 2$

Where the curve x^2 intersects the line $3x + 2$, the equation is true.

$x =$ −0.6

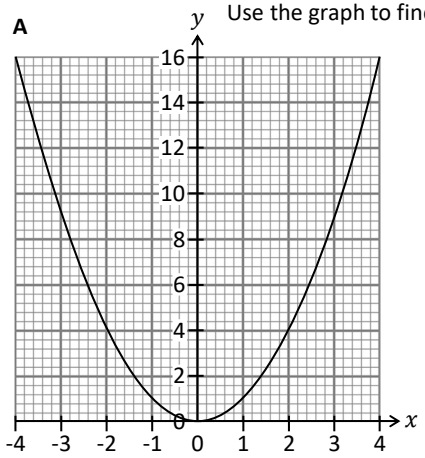
or

$x =$ _____

These are *estimates*.

A

Use the graph to find estimates for the solutions to:



$x^2 - x - 4 = 0$

rearrange ↓

$x^2 = x + 4$

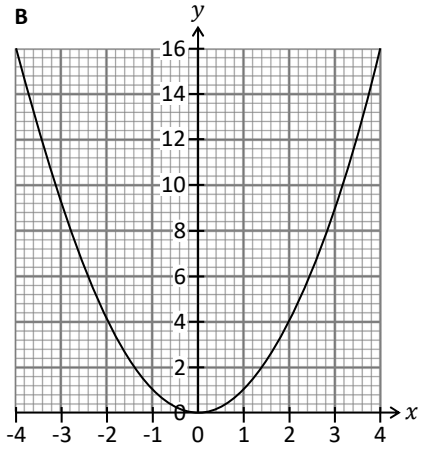
$x =$ _____

or

$x =$ _____

Use the graph to find estimates for the solutions of this equation.

B



$x^2 + 2x - 4 = 0$

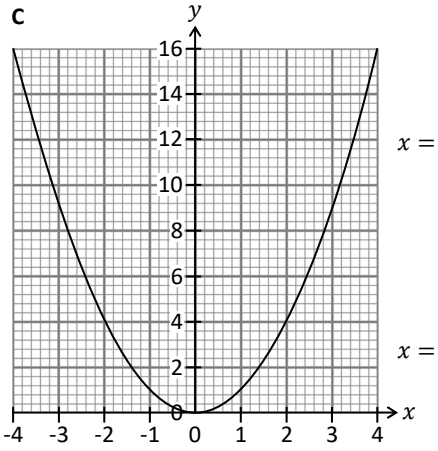
$x =$ _____

or

$x =$ _____

Use the graph to find estimates for the solutions to these equations.

C



$x^2 - 2x - 7 = 0$

$x =$ _____

$x^2 - 3x + 1 = 0$

$x =$ _____

Fluency Practice

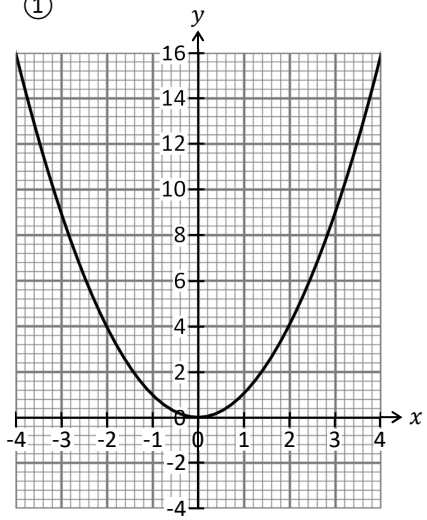
Solving Quadratic Equations: Intersection

① $y = x^2$

has been drawn on the grid.

Use the graph to solve the equation:

$x^2 - 3x - 2 = 0$

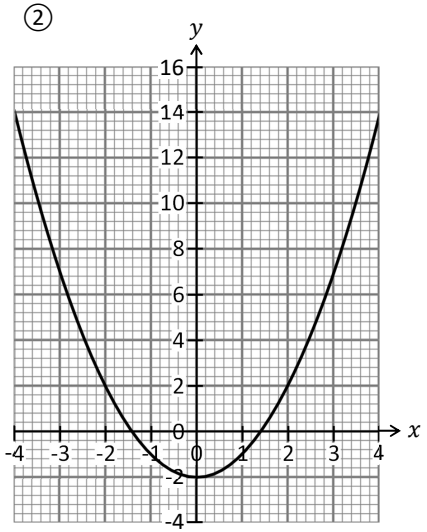


② $y = x^2 - 2$

has been drawn on the grid.

Use the graph to solve the equation:

$x^2 - x - 5 = 0$

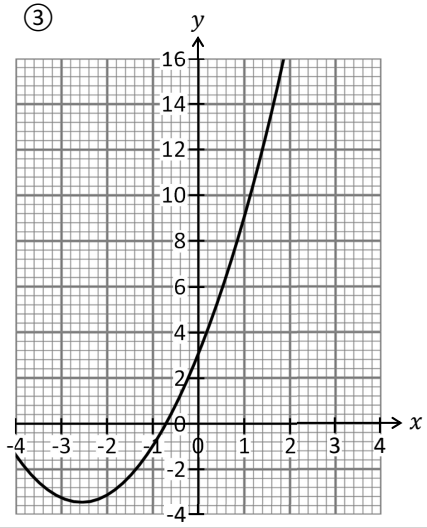


③ $y = x^2 + 5x + 3$

has been drawn on the grid.

Use the graph to solve the equation:

$x^2 + 3x - 1 = 0$

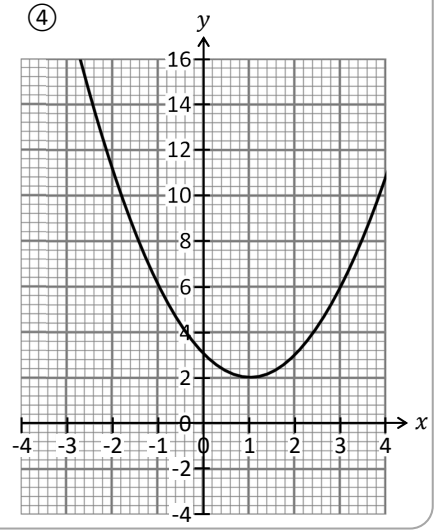


④ $y = x^2 - 2x + 3$

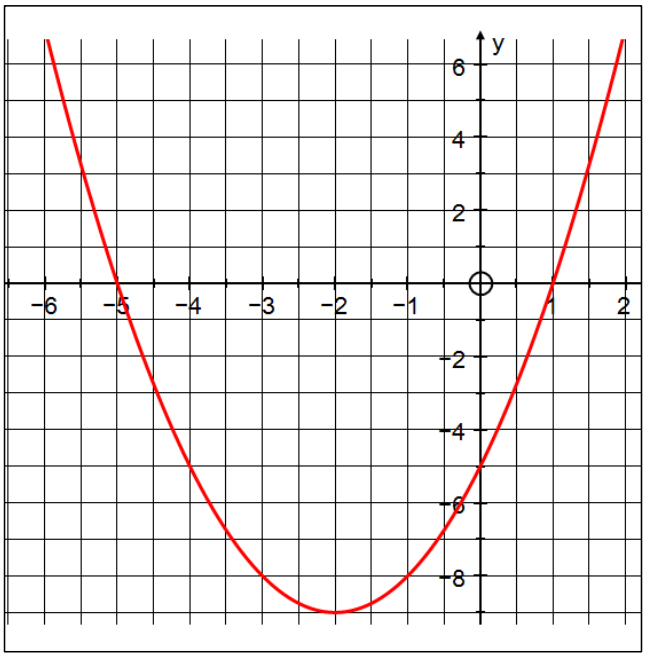
has been drawn on the grid.

Use the graph to solve the equation:

$x^2 + 2x - 2 = 0$



1) Here is the graph of $y = x^2 + 4x - 5$



Use the graph to solve the following equations:

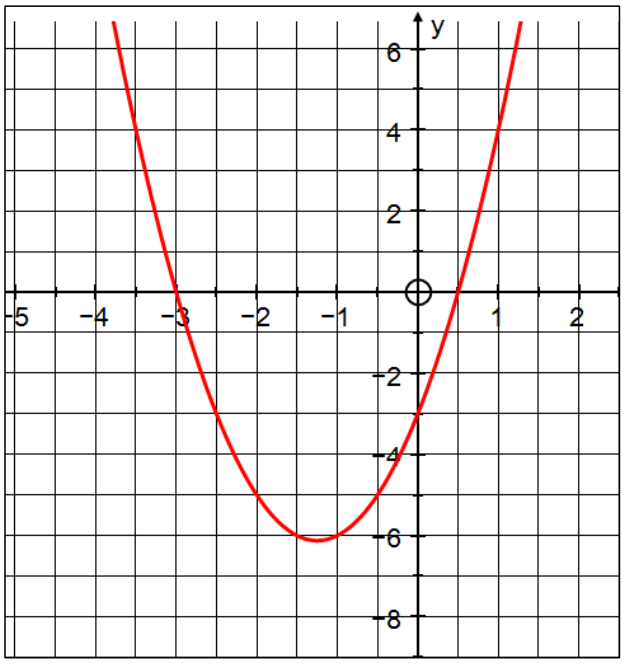
(a) $x^2 + 4x - 5 = 0$

(b) $x^2 + 4x - 5 = 4$

(c) $x^2 + 4x - 5 = -6$

(d) $x^2 + 4x - 5 = x$

2) Here is the graph of $y = 2x^2 + 5x - 3$



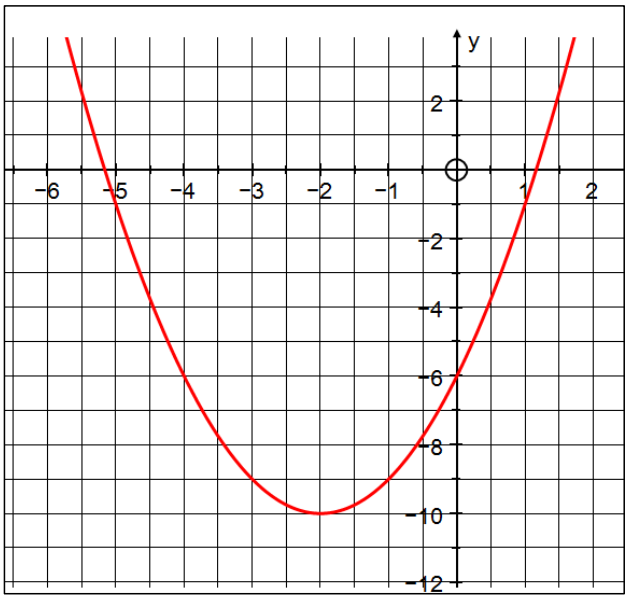
Use the graph to solve the following equations:

(a) $2x^2 + 5x - 3 = 2x + 1$

(b) $2x^2 + 5x = 5$

(c) $2x^2 + 5x + 2 = 0$

3) Here is the graph of $y = x^2 + 4x - 6$



Use the graph to solve the following equations:

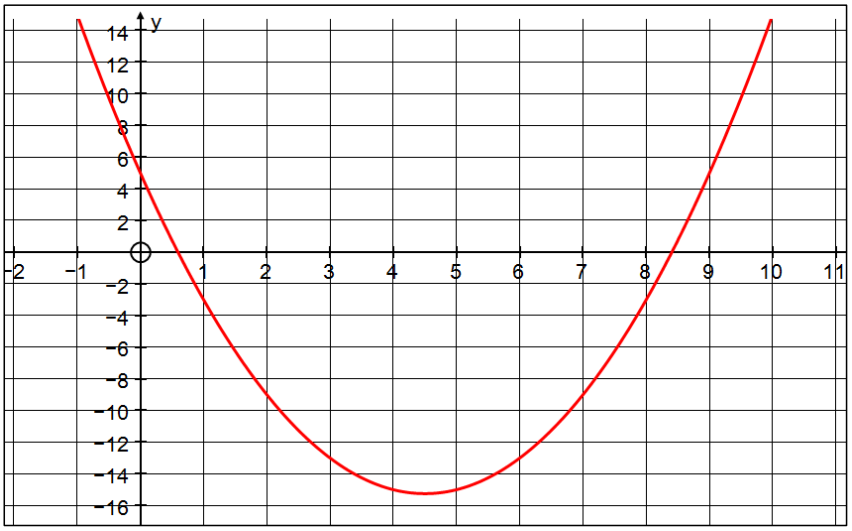
(a) $x^2 + 4x - 6 = -10$

(b) $x^2 + 4x - 6 = -11$

(c) $x^2 + 3x - 6 = 0$

(d) $x^2 + 5x - 2 = 0$

4) This is the graph of $y = x^2 - 9x + 5$



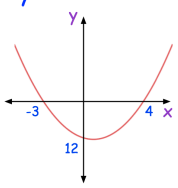
Use the graph to solve:

(a) $x^2 - 11x + 12 = 0$

(b) $x^2 - 6x + 3 = 0$

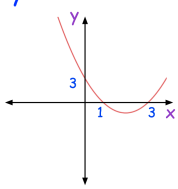
Question 1: Using the graphs below, solve each equation.

$y = x^2 - x - 12$



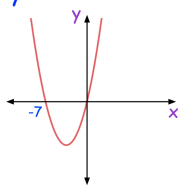
(a) Solve $x^2 - x - 12 = 0$

$y = x^2 - 4x + 3$



(b) Solve $x^2 - 4x + 3 = 0$

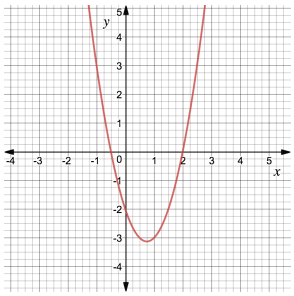
$y = x^2 + 7x$



(c) Solve $x^2 + 7x = 0$

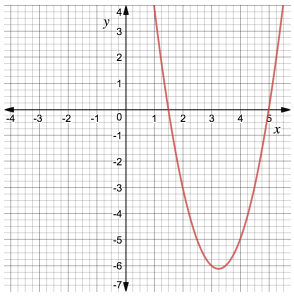
Question 2: Using the graphs below, solve each equation

$y = 2x^2 - 3x - 2$



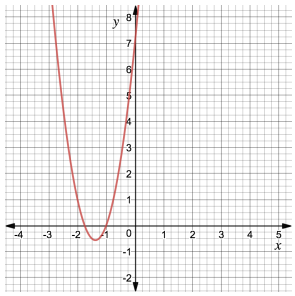
(a) Solve $2x^2 - 3x - 2 = 0$

$y = 2x^2 - 13x + 15$



(b) Solve $2x^2 - 13x + 15 = 0$

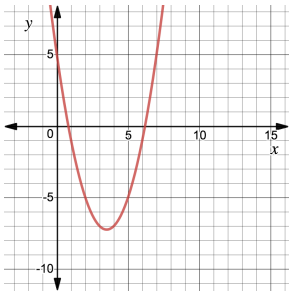
$y = 4x^2 + 11x + 7$



(c) Solve $4x^2 + 11x + 7 = 0$

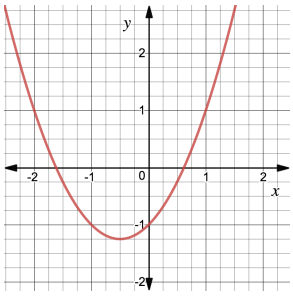
Question 3: Using the graphs, find estimates of the solutions to the following equations

$y = x^2 - 7x + 5$



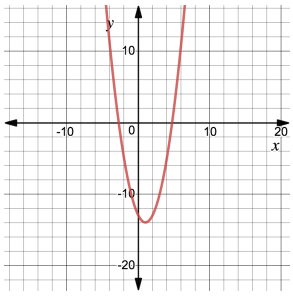
(a) $x^2 - 7x + 5 = 0$

$y = x^2 + x - 1$



(b) $x^2 + x - 1 = 0$

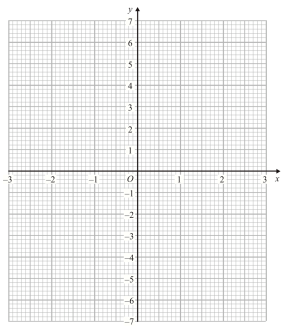
$y = x^2 - 2x - 13$



(c) $x^2 - 2x - 13 = 0$

Question 4: (a) Complete the table of values of $y = x^2 - x - 5$

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



(b) On a copy of the grid, draw the graph of $y = x^2 - x - 5$ for the value of x from -3 to 3

(c) Use your graph to find estimates of the solutions to the equation $x^2 - x - 5 = 0$

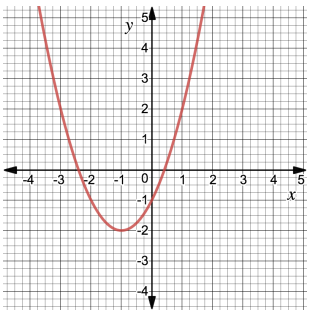
Question 5: Solve each of the following equations graphically

(a) $x^2 - 3x - 3 = 0$ (b) $x^2 + 8x + 5 = 0$ (c) $x^2 - 2x - 1 = 0$

(d) $x^2 - 5x - 8 = 0$ (e) $x^2 + 4x - 10 = 0$ (f) $2x^2 + 3x - 6 = 0$

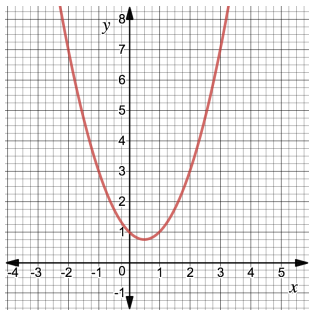
Question 6: Using the graphs below, solve each equation

$y = x^2 + 2x - 1$



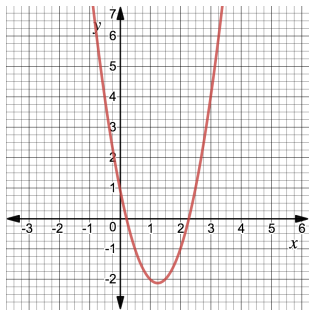
(a) Solve $x^2 + 2x - 1 = 2$

$y = x^2 - x + 1$



(b) Solve $x^2 - x + 1 = 7$

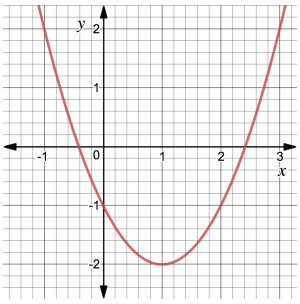
$y = 2x^2 - 5x + 1$



(c) Solve $2x^2 - 5x + 1 = 1$

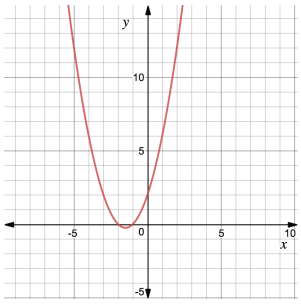
Question 7: Using the graphs, find estimates of the solutions to the following equations

$y = x^2 - 2x - 1$



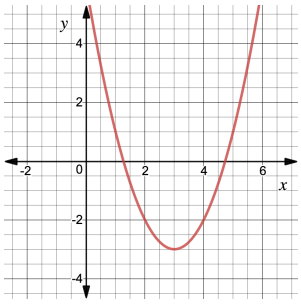
(a) $x^2 - 2x - 1 = 1$

$y = x^2 + 3x + 2$



(b) $x^2 + 3x + 2 = 11$

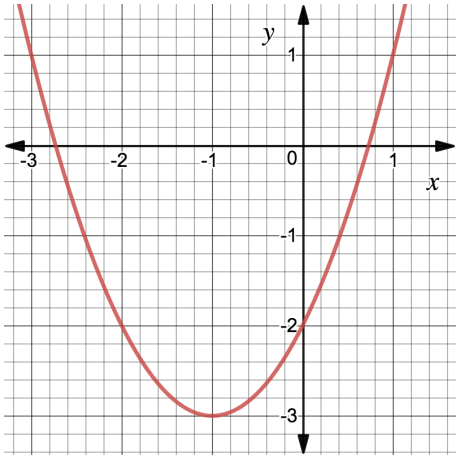
$y = x^2 - 6x + 6$



(c) $x^2 - 6x + 6 = -1$

Apply

Question 1: The graph of $y = f(x)$ is drawn on the grid.

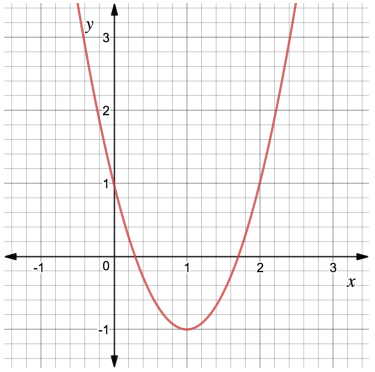


(a) Write down estimates for the roots of $f(x) = 0$

(b) Use the graph to find an estimates for the roots of $f(x) = -1$

(c) Write down the coordinates of the turning point of the graph

Question 2: The grid below shows the graph of $y = 2x^2 - 4x + 1$



The graph of $2x^2 - 4x + 1 = k$ has exactly one solution.

Use the graph to find the value of k

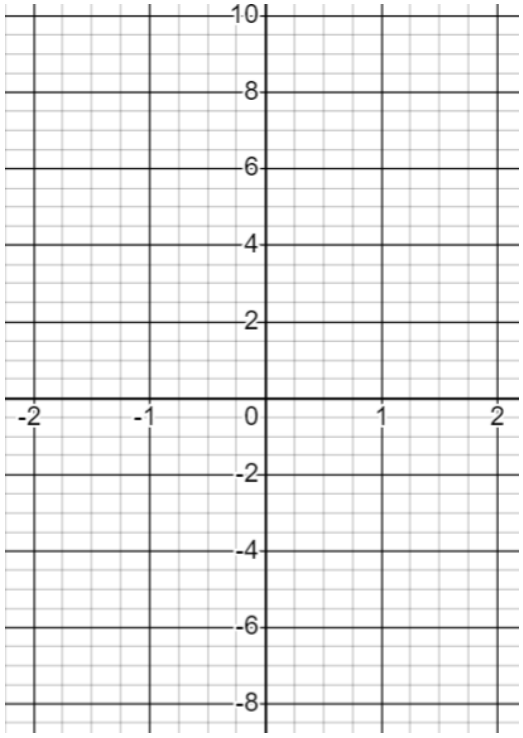
Fluency Practice

Plotting Cubic Graphs

(a)

Plot the graph of $y = x^3 + 1$ from $x = -2$ to $x = 2$

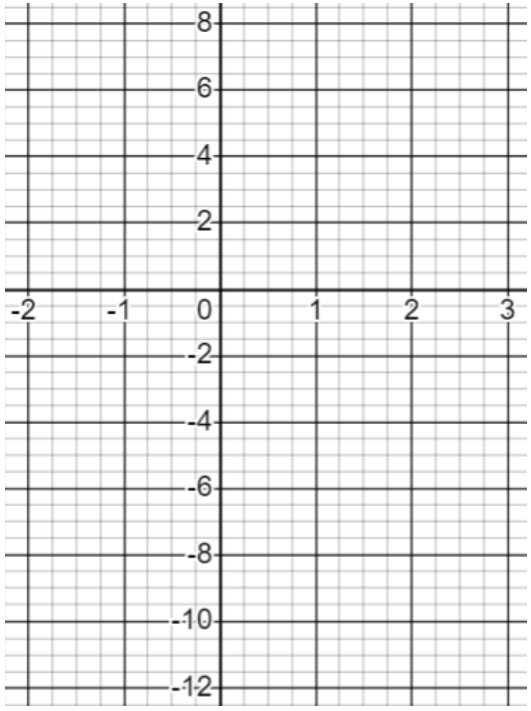
x	-2	-1	0	1	2
y					



(b)

Plot the graph of $y = x^3 - 2x^2 - x + 2$ from $x = -2$ to $x = 3$

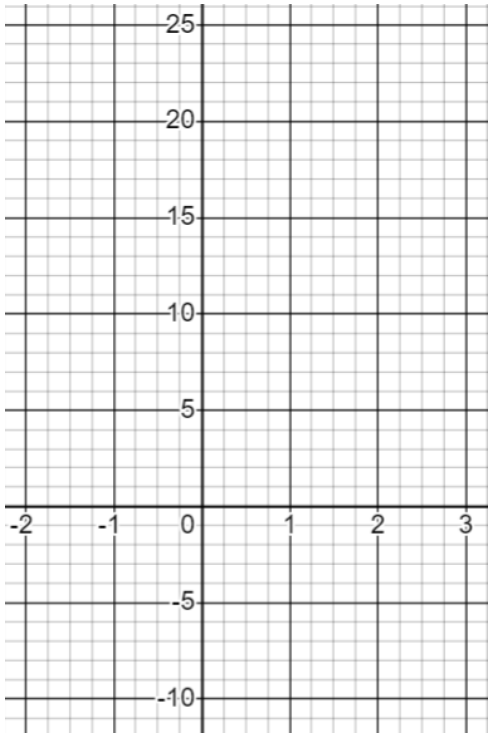
x	-2	-1	0	1	2	3
y						



(c)

Plot the graph of $y = 3 - x + 2x^2 - x^3$ from $x = -2$ to $x = 3$

x	-2	-1	0	1	2	3
y						



Fluency Practice

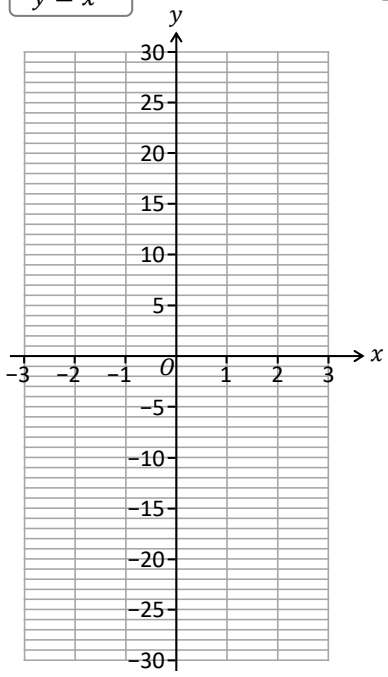
Plotting Cubics

Use a table of values to plot each graph.
What effect does each term in the equation have on the cubic shape?
What comments can you make about the changing gradient of each curve?

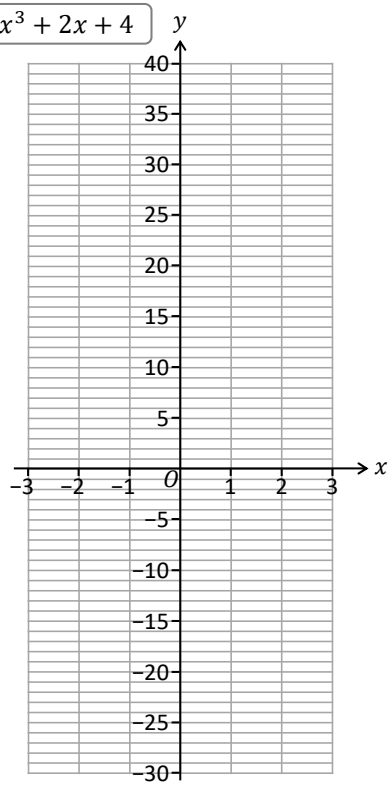
x	−3	−2	−1	0	1	2	3
y							

x	−3	−2	−1	0	1	2	3
y							

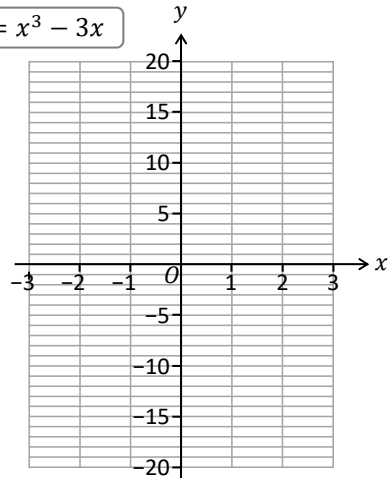
$y = x^3$



$y = x^3 + 2x + 4$

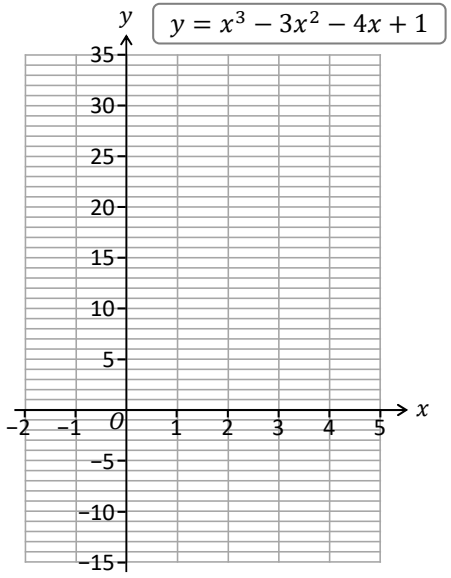


$y = x^3 - 3x$



x	y
−3	
−2	
−1	
0	
1	
2	
3	

$y = x^3 - 3x^2 - 4x + 1$



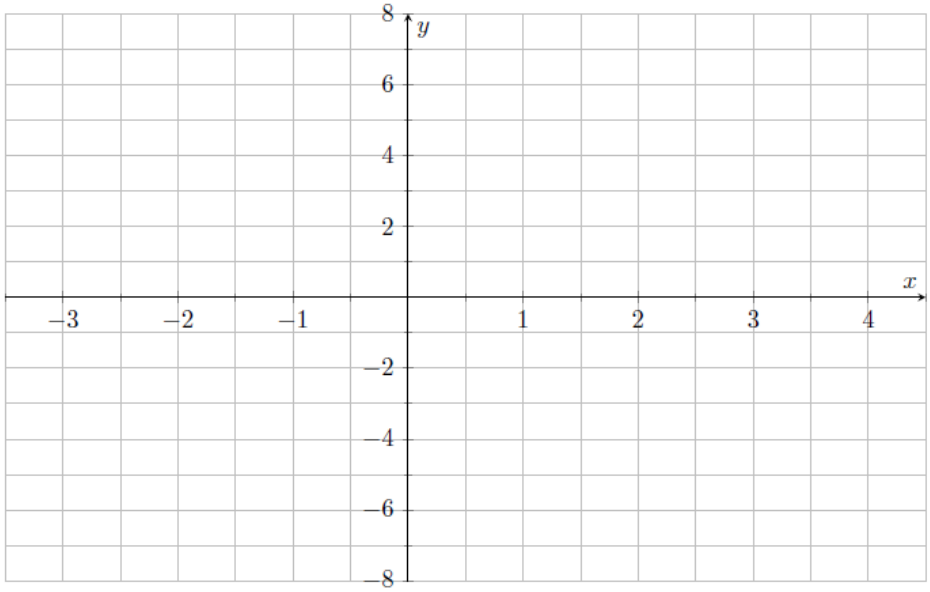
x	y
−3	
−2	
−1	
0	
1	
2	
3	

Solving Equations Graphically

(a)

Plot the graph of $y = 6 + x - x^2$. Use the graph to find the solutions to equation

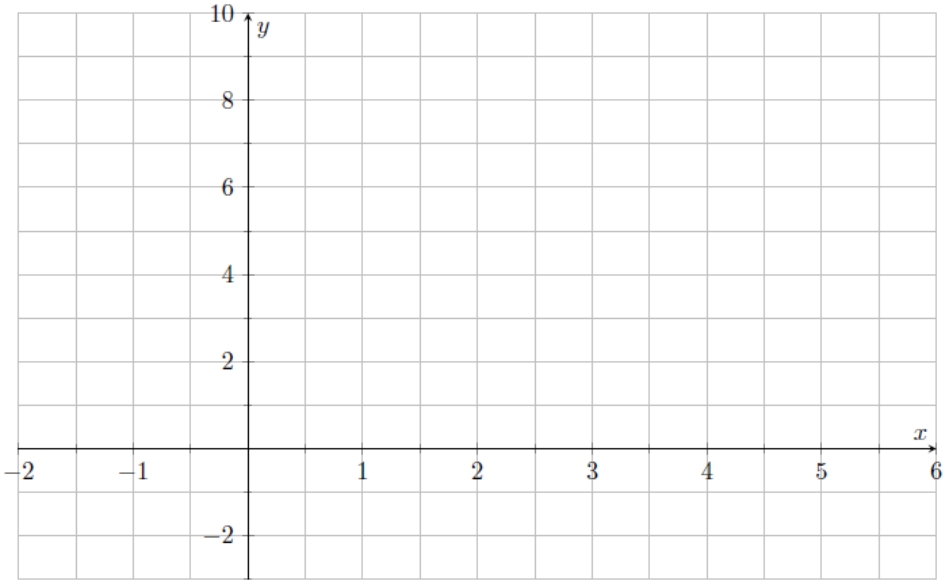
(a) $6 + x - x^2 = 0$ (b) $6 + x - x^2 = -6$



(b)

Plot the graph of $y = x^2 - 4x + 3$. Use the graph to find the solutions to equation

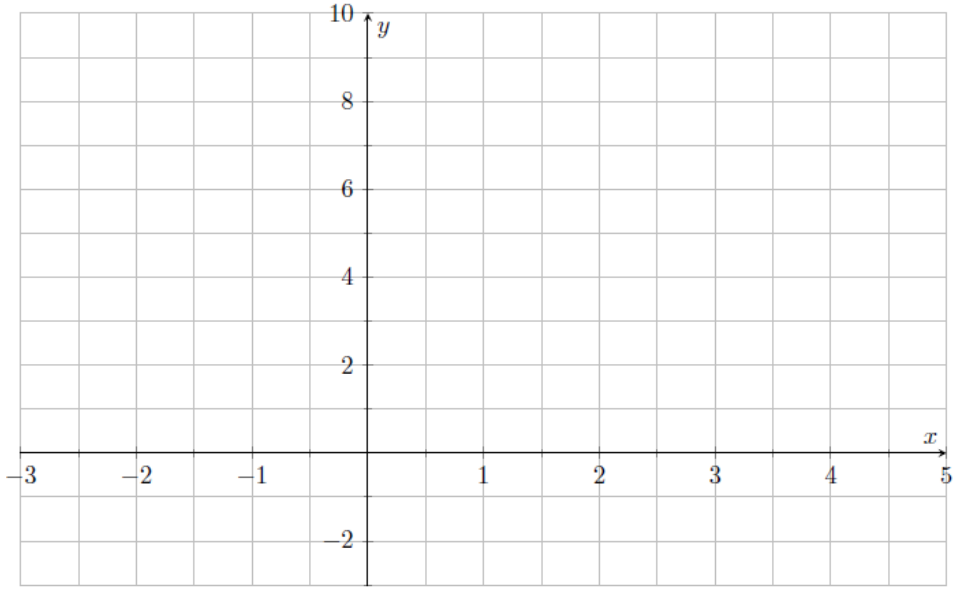
(a) $x^2 - 4x + 3 = 0$ (b) $x^2 - 4x + 3 = 8$



(c)

Plot the graph of $y = 8 + 2x - x^2$. Use the graph to find the solutions to the equation

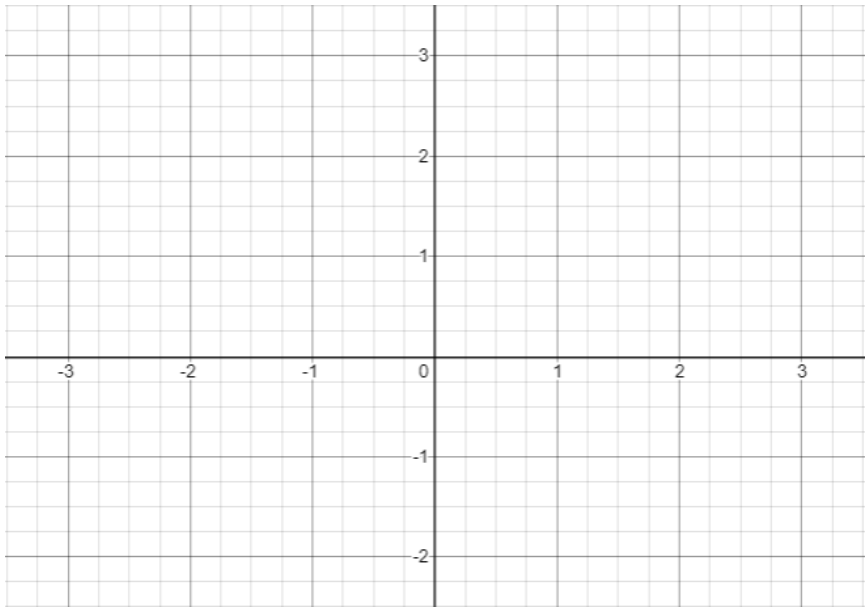
(a) $8 + 2x - x^2 = 5$ (b) $8 + 2x - x^2 = 8 - x$



(d)

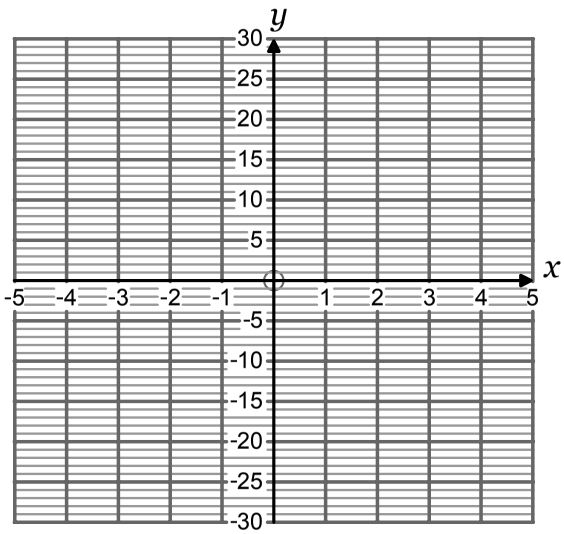
Plot the graph of $y = x^3 - 3x$. Use the graph to estimate the solutions to the equation

(a) $x^3 - 3x = 1$ (b) $x^3 - 3x = x + 1$



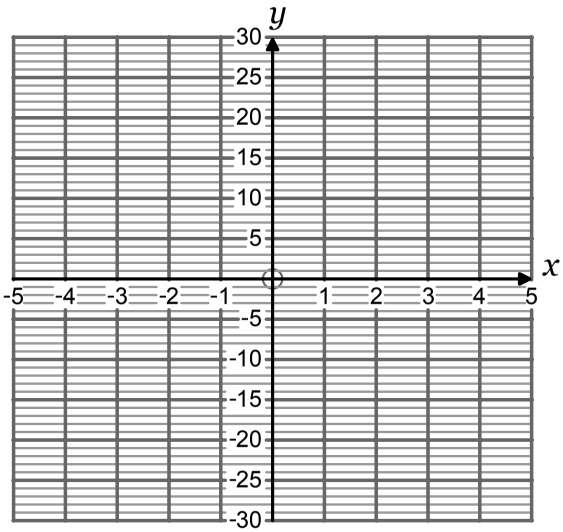
1. Plot the graph of $y = x^3$

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



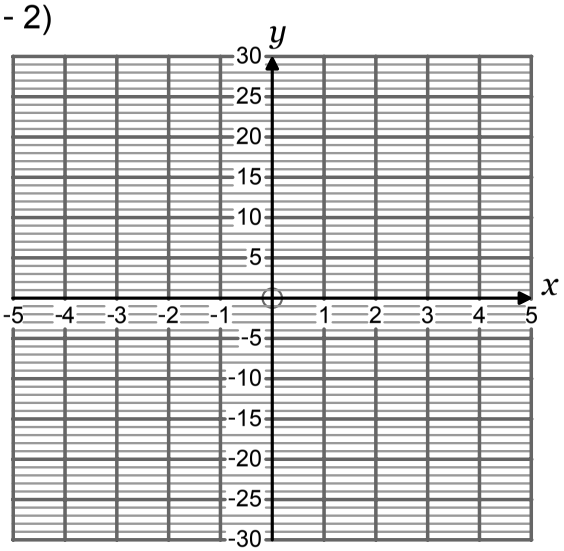
2. Plot the graph of $y = 9x - x^3$

x	y
-4	
-3	
-2	
-1	
0	
1	
2	
3	
4	



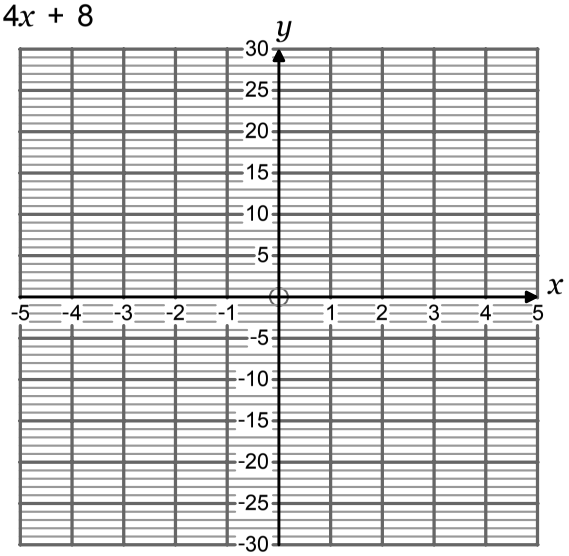
3. Plot the graph of $y = x(x+3)(x-2)$

x	y
-4	
-3	
-2	
-1	
0	
1	
2	
3	
4	



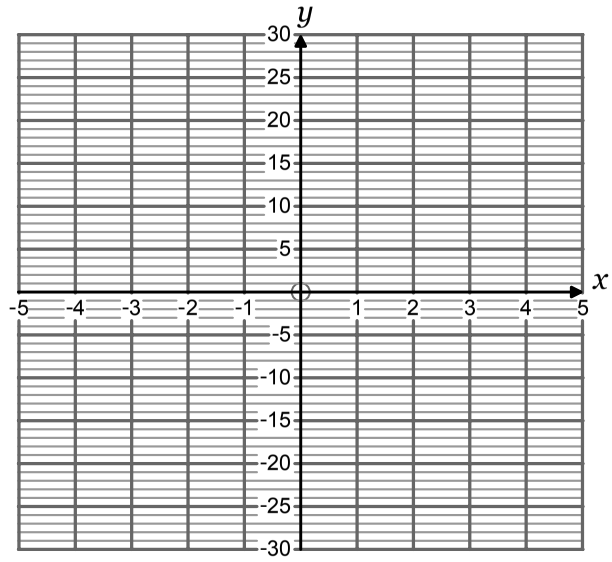
4. Plot the graph of $y = x^3 - 2x^2 - 4x + 8$

x	y
-3	
-2	
-1	
0	
1	
2	
3	
4	



5. Plot the graph of $y = -(x+1)^3$

x	y
-4	
-3	
-2	
-1	
0	
1	
2	



6. True or false?

a) All cubic graphs pass through the origin.

b) All cubic graphs have a line of symmetry.

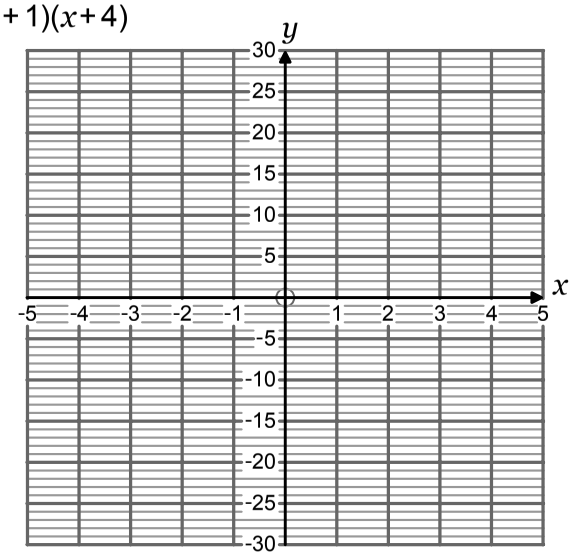
c) All cubic graphs intersect the x-axis at least once.

d) The coefficient of x^3 determines the shape of the graph.

e) Cubic graphs have asymptotes.

7. a) Plot the graph of $y = (x - 3)(x+1)(x+4)$

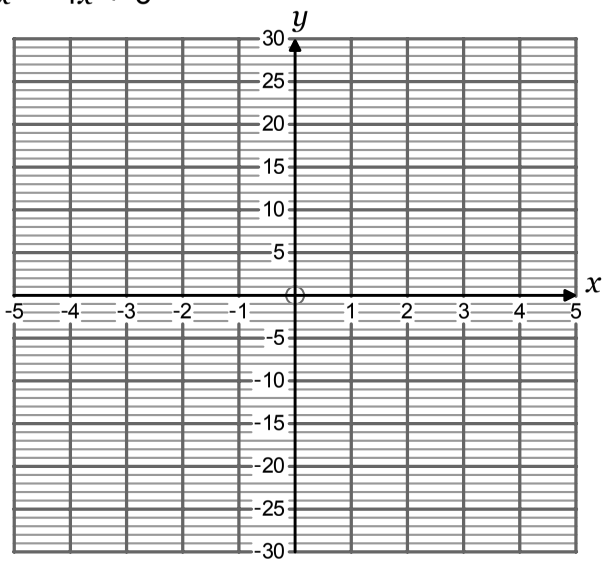
x	y
-5	
-4	
-3	
-2	
-1	
0	
1	
2	
3	



b) Use your graph to estimate the solutions of: $(x - 3)(x+1)(x+4) = 5$

8. a) Plot the graph of $y = -x^3 + x^2 - 4x + 5$

x	y
-2	
-1	
0	
1	
2	
3	



b) Use your graph to estimate the solution of: $-x^3 + x^2 - 4x + 5 = -15$

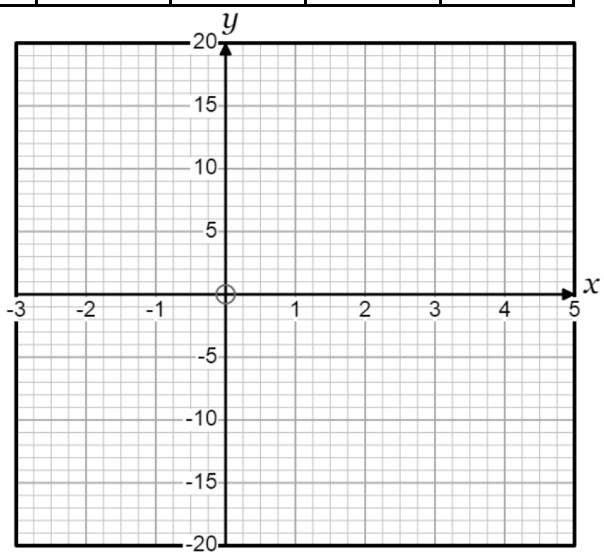
9. Work out the y-intercept of the graphs of each of these cubic functions.

a) $y = x^3 + 4$ b) $y = 2x^3 + x - 1$ c) $y = -x^3$

d) $y = x(x^2 + 4)$ e) $y = (x + 3)^3$ f) $y = (x - 2)(x - 3)^2$

1. Draw the graph of $y = x^3 - 4x^2 + 3$

x	-2	-1	0	1	2	3	4
y							

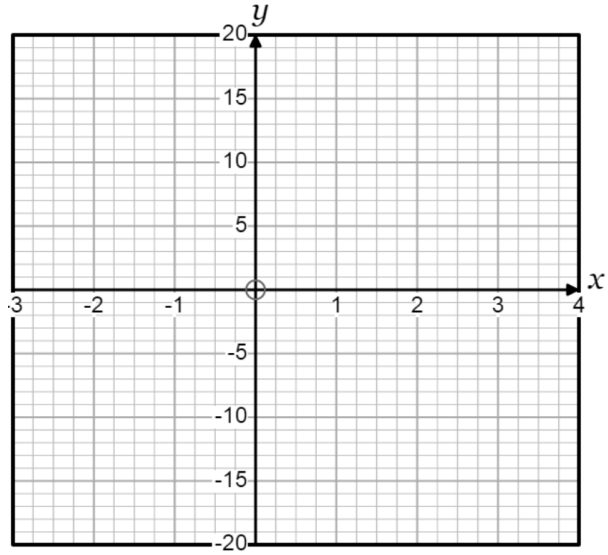


2. Estimate the roots of $y = x^3 - 4x^2 + 3$

3. Estimate the co-ordinates of the turning points of $y = x^3 - 4x^2 + 3$

4. Draw the graph of $y = 2x(x-2)(x+2)$

x	-2.5	-2	-1	0	1	2	2.5
y							



5. What are the roots of $y = 2x(x-2)(x+2)$?

6. Estimate the co-ordinates of the turning points of $y = 2x(x-2)(x+2)$

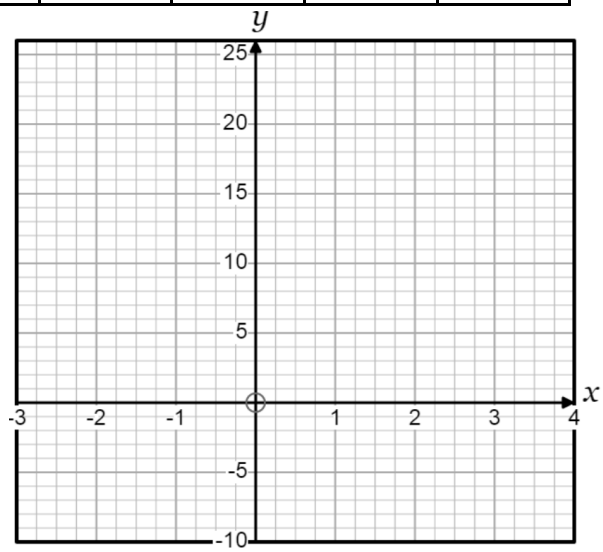
7. Draw the graph of $y = 5 - x^3 + 3x^2$

x	-2	-1	0	1	2	3	4
y							

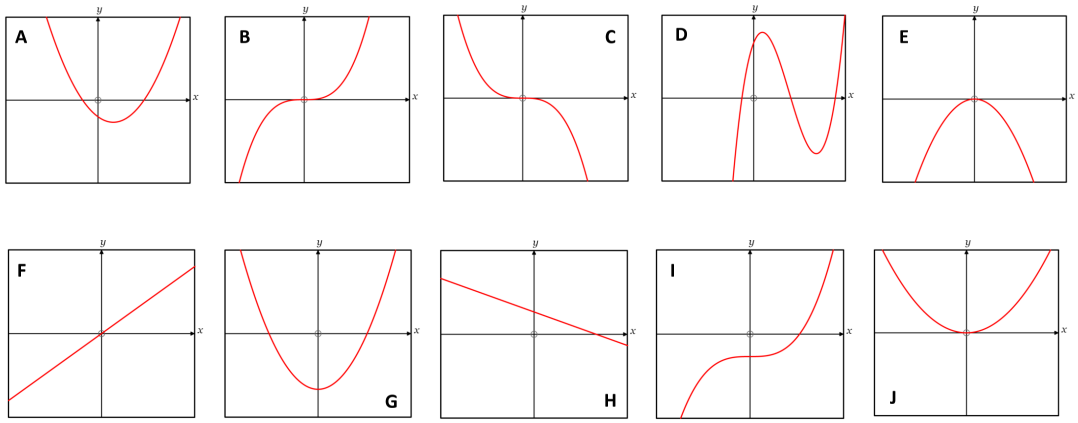
8. Estimate the roots of $y = 5 - x^3 + 2x^2$

9. Estimate the co-ordinates of the turning points of $y = 5 - x^3 + 2x^2$

10. Why is this cubic graph 'upside down'?



11. Match the graphs to their functions:



$y = -x^2$ $y = 2x$ $y = (x-3)(x+1)$ $y = x^2 - 10$ $y = -x^3$

$y = 4 - x$ $y = 0.5x^2$ $y = x^3$ $y = x^3 - 3$ $y = (x-5)(x-3)(x+1)$

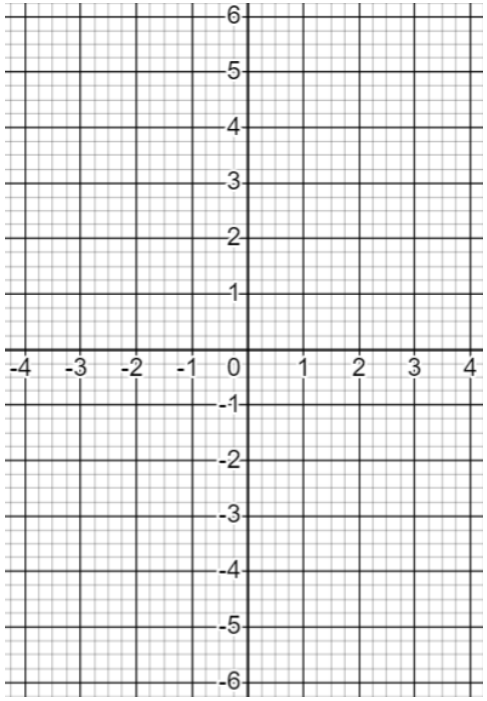
Fluency Practice

Plotting Reciprocal Graphs

(a)

Plot the graph of $y = \frac{2}{x}$ from $x = -4$ to $x = 4$

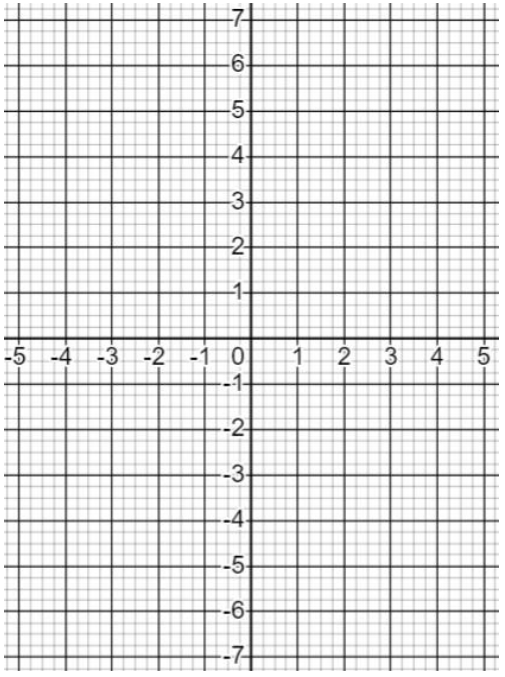
x	-4	-2	-1	0	1	2	4
y							



(b)

Plot the graph of $y = -\frac{5}{x}$ from $x = -5$ to $x = 5$

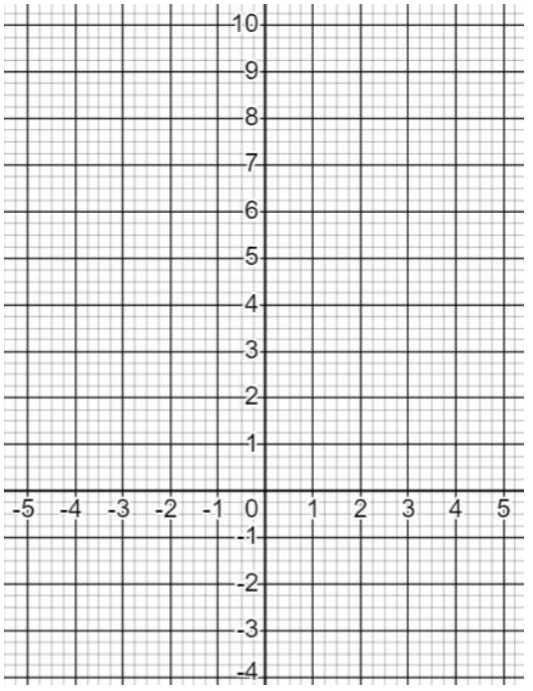
x	-5	-2	-1	0	1	2	5
y							



(c)

Plot the graph of $y = \frac{10}{x^2}$ from $x = -2$ to $x = 3$

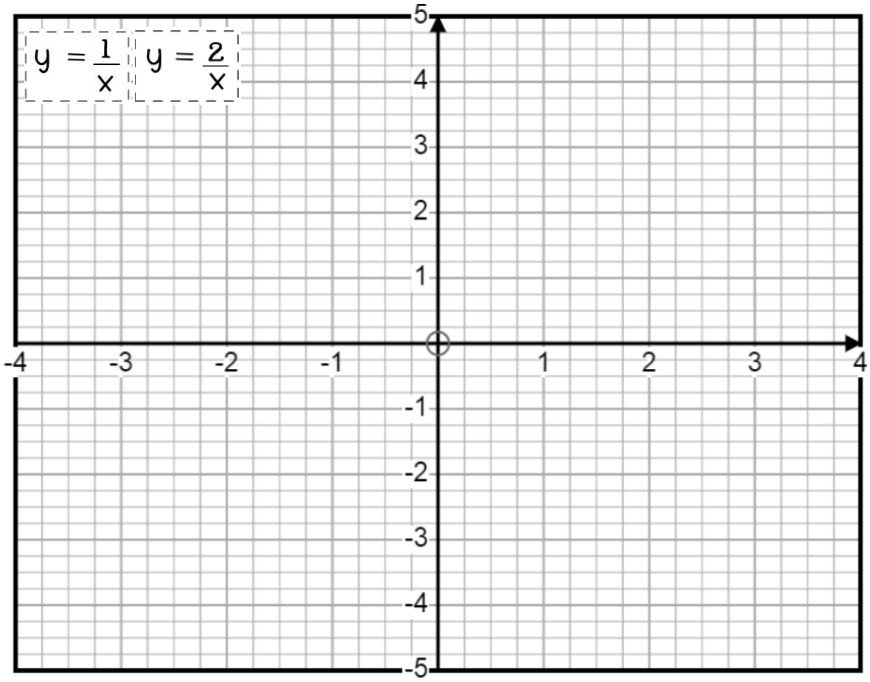
x	-5	-2	-1	0	1	2	5
y							



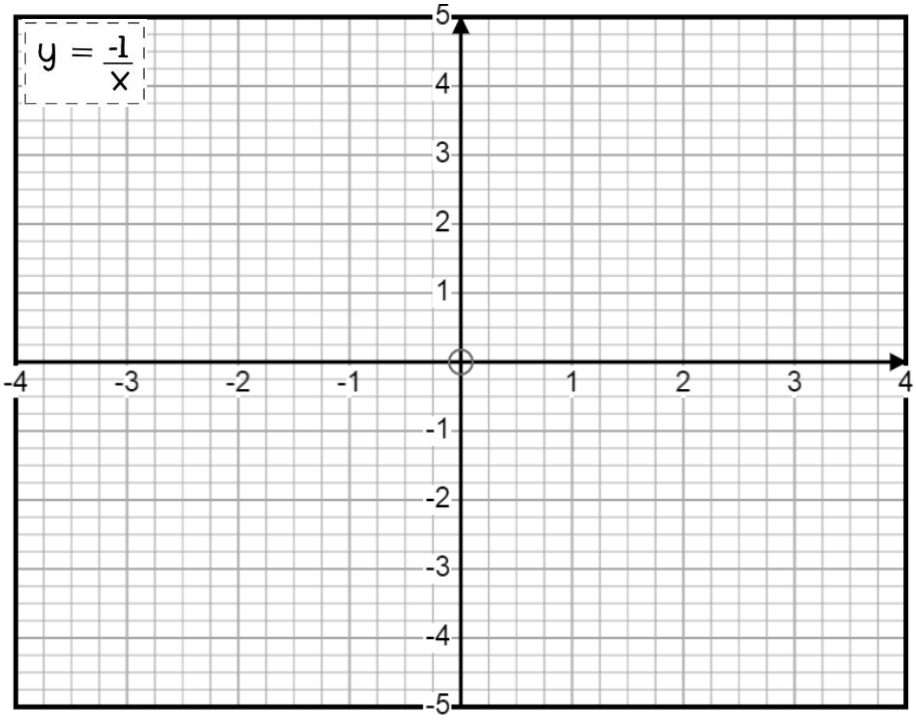
reciprocal functions

These functions involve **dividing by x**.
What shape do their graphs make?
Draw two graphs on the first set of axes.

x	$y=\frac{1}{x}$	$y=\frac{2}{x}$
-4		
-3		
-2		
-1		
-0.5		
-0.25		
0		
0.25		
0.5		
1		
2		
3		
4		



x	y
-4	
-3	
-2	
-1	
-0.5	
-0.25	
0	
0.25	
0.5	
1	
2	
3	
4	

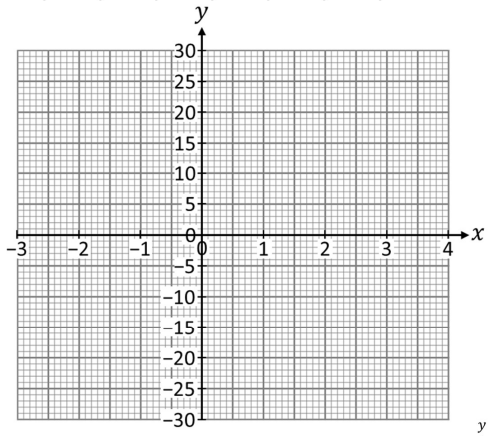


Fluency Practice

Plotting Cubic & Reciprocal Graphs

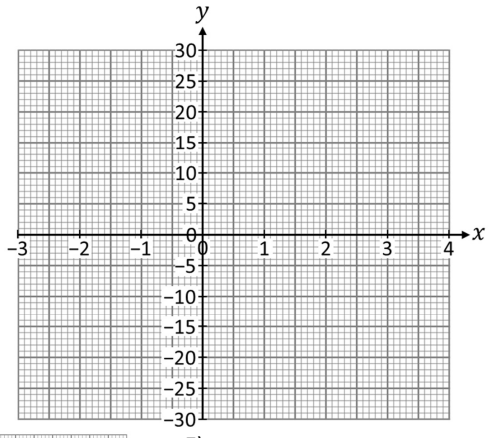
A) Plot the graph of $y = x^3$ for values of x from −3 to 3

x	−3	−2	−1	0	1	2	3
y	−27						



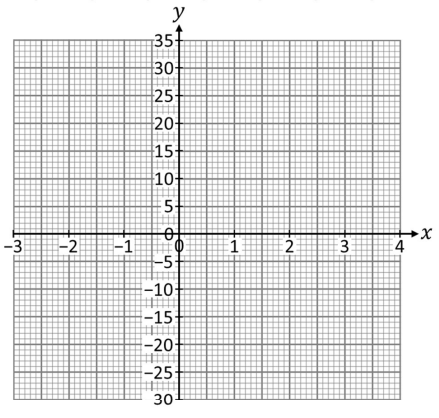
B) Plot the graph of $y = x^3 - 4$ for $-2 \le x \le 3$

x	−2	−1	0	1	2	3
y						



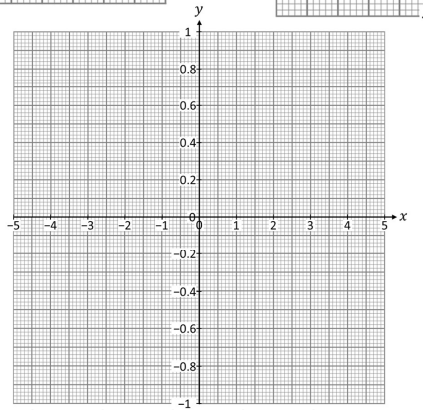
C) Plot the graph of $y = 5 - x^3$ for $-3 \le x \le 3$

x	−3	−2	−1	0	1	2	3
x^3							
y							



D) Plot the graph of $y = \frac{1}{x}$ for $-5 \le x \le 5$

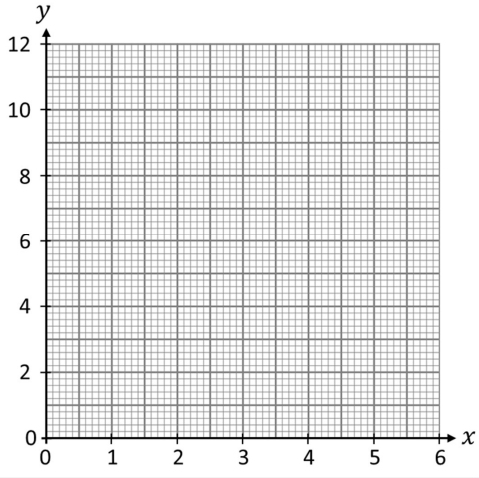
Why is there no value when $x = 0$?



x	−5	−4	−2	−1	0	1	2	4	5
y									

E) Plot the graph of $y = \frac{12}{x}$ for $0 \le x \le 6$

For your table of values, choose values for x that produce integer answers.



exponential functions

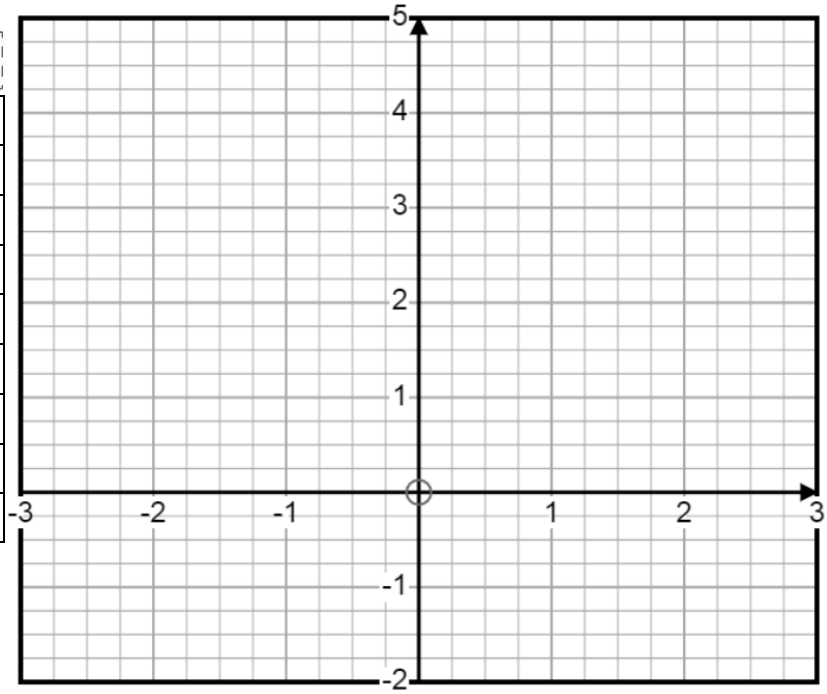
These functions have **x as a power.**
What shape do their graphs make?
Draw two functions on each set of axes.

$y = 2^x$

x	y
-3	
-2	
-1	
-0.5	
0	
0.5	
1	
2	

$y = 4^x$

x	y
-3	
-2	
-1	
-0.5	
0	
0.5	
1	
2	

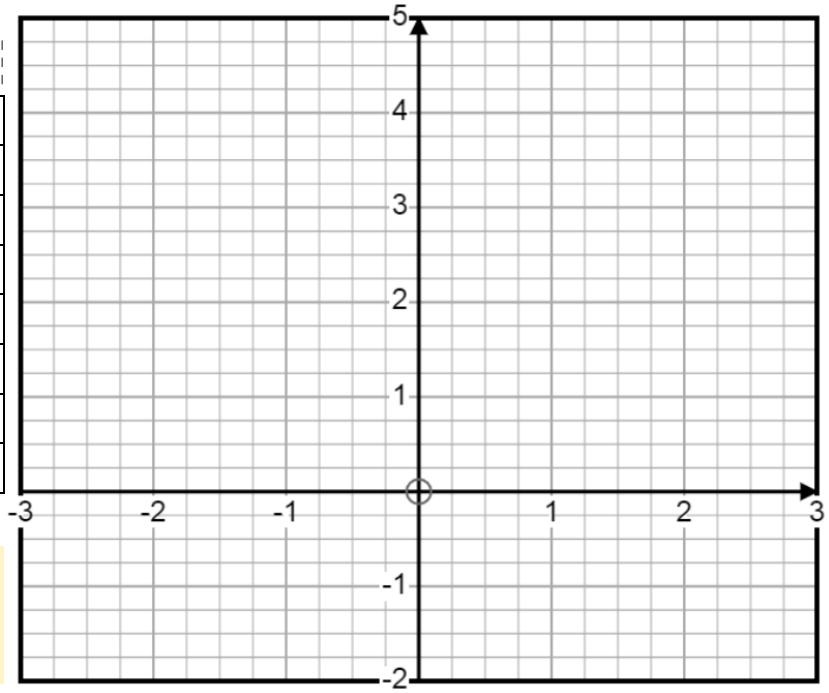


$y = 0.5^x$

x	y
-2	
-1	
-0.5	
0	
0.5	
1	
2	

$y = 4^{-x}$

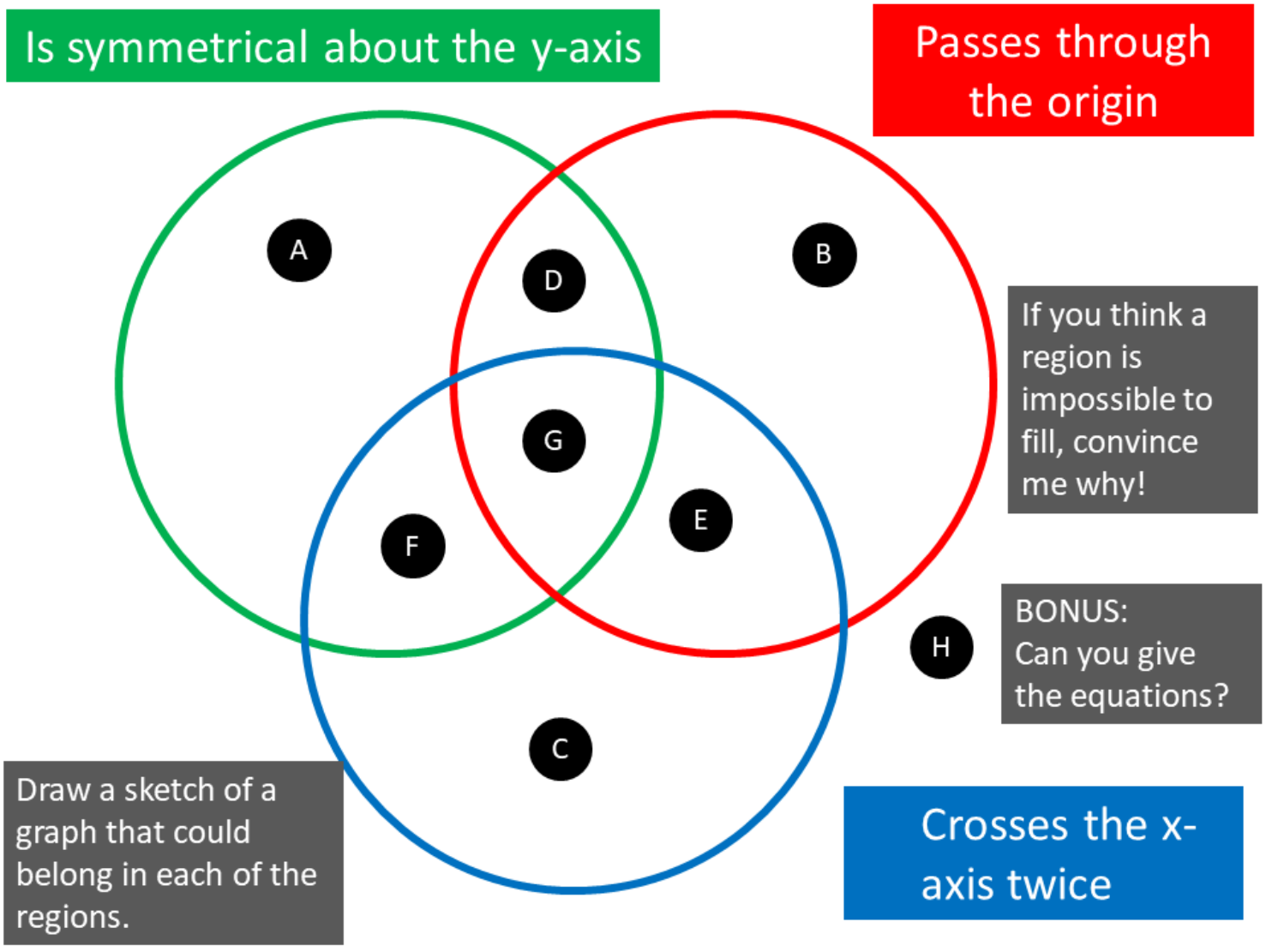
x	y
-2	
-1	
-0.5	
0	
0.5	
1	
2	



extension

All of these graphs pass through (0,1). Why?

Maths Venns

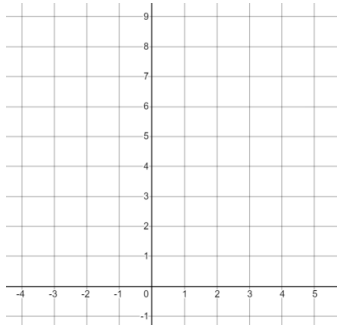

Is symmetrical about the y-axis
Passes through the origin
A
D
B
G
F
E
H
C
If you think a region is impossible to fill, convince me why!
BONUS:
Can you give the equations?
Draw a sketch of a graph that could belong in each of the regions.
Crosses the x-axis twice

Fluency Practice

(a)

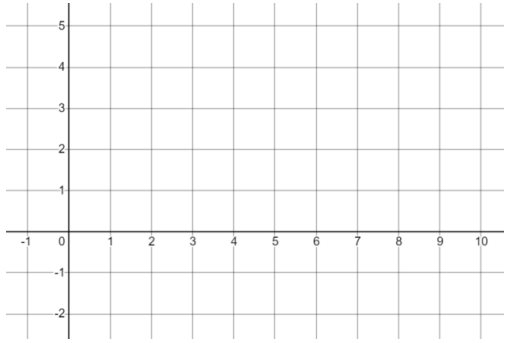
Plot the graph of the equation $y = 2x + 3$

x	-2	-1	0	1	2	3
y						



(b)

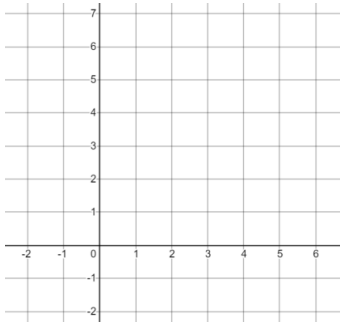
On the grid, plot the graph of $2x - 3y = 6$ from $x = 0$ to $x = 9$



(c)

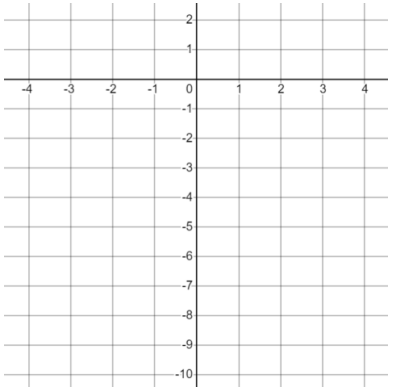
Plot the graph of $y = x^2 - 4x + 2$

x	-1	0	1	2	3	4	5
y							



(d)

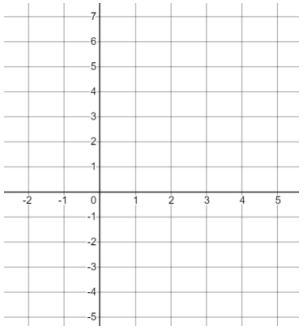
Plot the graph of $y = 2 + x - x^2$ for $x = -3$ to $x = 3$



(e)

Plot the graph of $y = x^3 - 4x^2 + 5$

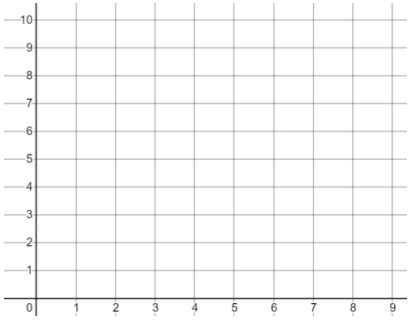
x	-1	0	1	2	3	4
y						



(f)

Plot the graph of $y = x + \frac{8}{x}$

x	1	2	3	4	6	8
y						



Fluency Practice

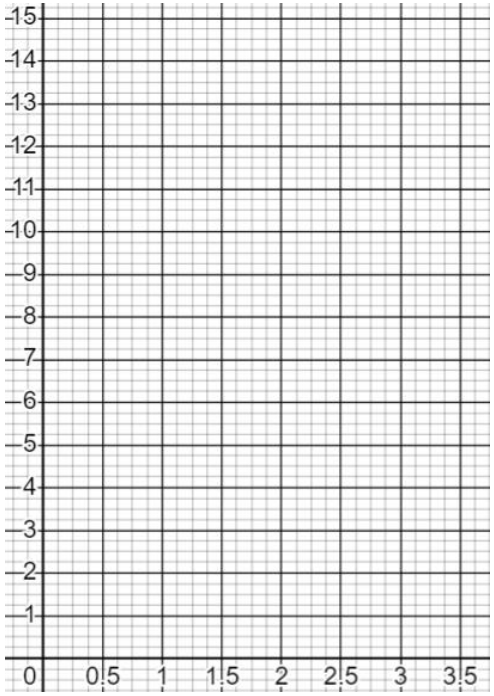
Plotting Harder Non-Linear Graphs

(a)

Plot the graph of $y = x^2 + \frac{2}{x^2}$

between $x = 0.5$ and $x = 3.5$

x	0.5	1	1.5	2	2.5	3	3.5
y							

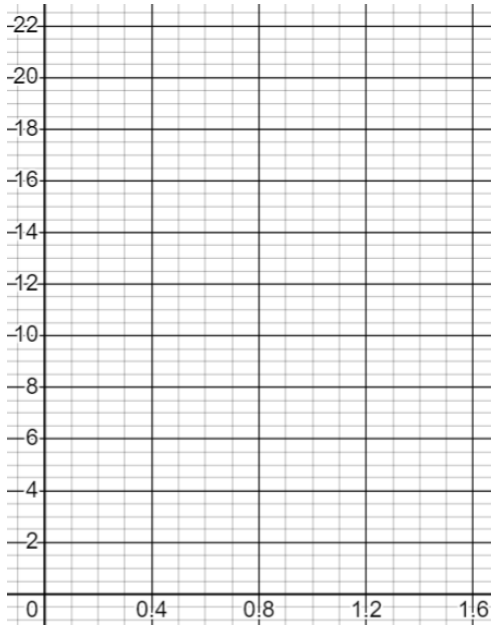


(b)

Plot the graph of $y = x^3 + 3x + \frac{2}{x}$

from $x = 0.1$ to $x = 1.5$

x	0.1	0.2	0.4	0.7	1	1.2	1.5
y							



(c)

Plot the graph of $y = x\left(\frac{x}{2} - \frac{1}{x^2}\right)$

from $x = -4$ to $x = -0.5$

x	-4	-3	-2	-1	-0.5	-0.25
y