

# Securing Grade 4/5

## Algebra Revision Question Booklet

Remember the only real failure  
in life is the failure to try!

Success doesn't come to you,  
**YOU GO TO IT!**

Name:

## Algebra

Topic	Hegartymaths clip number	Watched Hegarty video	Watched GCSEpod	Attempted questions	Checked my answers
Simplifying Expressions (including collecting like terms)	156-159				
Algebraic Indices	173-175				
Expanding Brackets	160-166				
Factorising Expressions	168-169 223-225				
Solving Linear Equations	177-186				
Constructing Equations	188				
Rearranging Formulae	280-284				
Sequences	197-198, 263				
Linear Graphs	206-208				
Quadratic, Cubic and Reciprocal Graphs	251, 298-299, 300-301				
Linear Simultaneous Equations	190-195, 218-219				

## Example Questions Collecting like terms

Simplify:

(a)  $a + a + a + a = 4a$

(b)  $2b + c + 3b + 2c = 5b + 3c$

(c)  $4a - b + 2b - 2a = 2a + b$

(d)  $w^2 + w^2 = 2w^2$

(e)  $4x^2 - x^2 = 3x^2$

(f)  $5x^2 + x - x^2 + 9x = 4x^2 + 10x$

(g) Write an expression for the perimeter of the rectangle.

The sum of the sides.

$5a + 2$   
 $a + 4$

$5a + 2 + 5a + 2 + a + 4 + a + 4$   
 $= 12a + 12$   
 Answer

A) Simplify:

1)  $b + b + b + b + b$

2)  $3a + 7a + 2a + a$

3)  $f + 2f + f + 9f$

4)  $7a + b + 2b + a$

5)  $4a + c + 2b + 3b + 5c$

6)  $8e + f + 5f + 2e$

7)  $10a - c + 2a - 3c$

8)  $3c + b - 3c + 4b$

9)  $8j - k + 3j - 5k - k$

10)  $6t + s - 2s + t - 3s + s$

11)  $7y + x + 5y - 7y - 2x$

12)  $8h + g - 5g + 9g - h$

13)  $9j - i + 2i - 8j - 4i$

14)  $9y + 2x - 11y - 2y + 9x$

15)  $2x^2 + 6x^2$

16)  $9y^3 + y^3$

17)  $8y^2 - 3y^2$

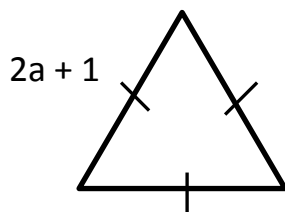
18)  $13a^4 - 2a^4$

19)  $2a^2 + 3a - a^2 + 5a$

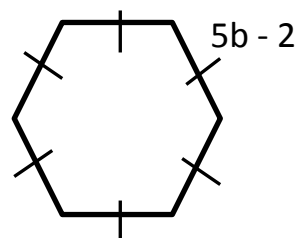
20)  $8y - 2y^3 + y^2 - y^3 + 4y^2$

B) Write an expression for the perimeter of each shape.

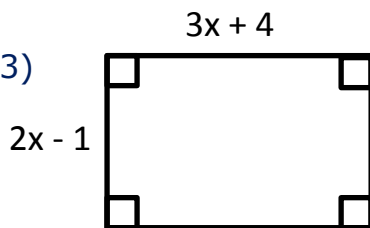
1)



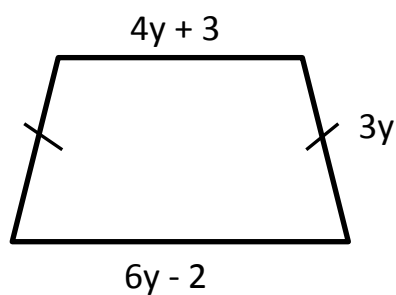
2)



3)

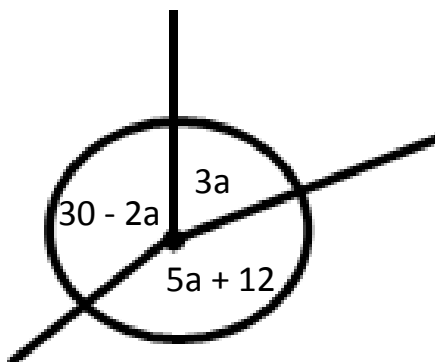


4)

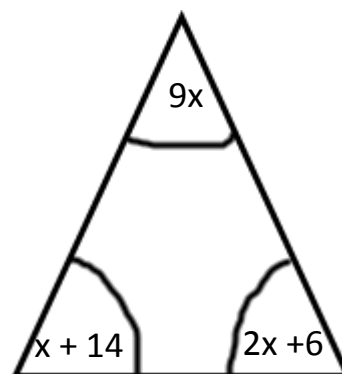


C) Write an expression for the sum of the angles below.

1)



2)



## Example Questions

### Multiplying and dividing terms

Simplify:

(a)  $4 \times c = 4c$

(b)  $e \times e = e^2$

HINT

Remember that multiplication is invisible in algebra e.g.  $6 \times e = 6e$

(c)  $5 \times a \times b \times a \times a = 5a^3b$

(d)  $4 \times a \times b \times 2 \times b = 8ab^2$

(e)  $7e \times 5f = 7 \times 5 \times e \times f$   
 $= 35ef$

(f)  $6m \times 2m = 6 \times 2 \times m \times m$   
 $= 12m^2$

(g)  $15a \div 3 = \frac{15a}{3} = 5a$

(h)  $16ab \div 8bc = \frac{16ab}{8bc} = \frac{2ab}{bc} = \frac{2a}{c}$

Simplify:

1)  $7 \times u$

2)  $6 \times a \times b$

3)  $8 \times e \times f$

4)  $a \times a$

5)  $c \times c \times c \times c$

6)  $a \times 3 \times c$

7)  $2 \times a \times 3$

8)  $5a \times 2$

9)  $8 \times 6y$

10)  $3a \times 4b$

11)  $2e \times 6f$

12)  $9p \times 4s$

13)  $3ab \times 6c$

14)  $11a \times 2ab$

15)  $7bc \times 2abc$

16)  $20a \div 4$

17)  $32c \div 8ab$

18)  $30ef \div 6fg$

19)  $15ef \div 45e$

20)  $12ab \div 15bc$

21)  $18abc \div 6abcd$

## Example Questions Algebraic Indices

Simplify:

(a)  $a^3 \times a^4 = a^{3+4} = a^7$

(b)  $3a^2 \times 5a^4 = 3 \times 5 \times a^2 \times a^4$

$= 15a^6$

(c)  $2a^3b \times 7a^2b^2 = 2 \times 7 \times a^3 \times a^2 \times b \times b^2$   
 $= 14a^5b^3$

(d)  $18a^5 \div 3a^2 = \frac{18 \times a^5}{3 \times a^2} = 6a^3$

(e)  $20a^5b^2 \div 4a^2b = \frac{20 \times a^5 \times b^2}{4 \times a^2 \times b}$

(f)  $\frac{a^3 \times a^7}{a^6} = \frac{a^{10}}{a^6} = a^4$

(g)  $\frac{4a^2 \times 3a^3}{6a^4} = \frac{12a^5}{6a^4} = 2a$

(h)  $(a^3)^5 = a^3 \times a^3 \times a^3 \times a^3 \times a^3$   
 $= a^{15}$

(i)  $(5a^5)^2 = 5a^5 \times 5a^5$   
 $= 25a^{10}$

(j)  $(2m^8n)^4 = 2m^8n \times 2m^8n \times 2m^8n \times 2m^8n$   
 $= 16m^{32}n^4$

Simplify:

1)  $k^8 \times k^3$

2)  $j^{11} \times j^8$

3)  $e^7 \times e^{13}$

4)  $m^{17} \times m^{12}$

5)  $s^4 \times s^3$

6)  $h^{12} \times h^3 \times h^4$

7)  $c^9 \times c^8 \times c^{-3}$

8)  $a^{-7} \times a^4 \times a^{-5}$

9)  $4a^7 \times 6a^4$

10)  $5h^{12} \times 4h^7$

11)  $7w^6 \times 3w^4$

12)  $3y^5 \times 3y^3$

13)  $5f^4 \times 7f^6$

14)  $4n^3 \times 3n^6$

15)  $12v^3 \times 6v^{41}$

16)  $7g^4 \times 9g^7$

17)  $4r^3 \times 5s^{15}$

18)  $6r^5 \times r^7 \times 3r^8$

19)  $5k^6 \times 7k^{11} \times 2k^3$

20)  $3s^5 \times 6s^7 \times t^3$

21)  $4y^8 \times 6x^{11} \times 2x^2 \times y^8$

22)  $2j^3 \times 3k^5 \times 5k^3 \times 2j^7$

23)  $b^{11} \div b^2$

24)  $f^{21} \div f^{11}$

25)  $d^4 \div d$

26)  $a^{13} \div a^{12}$

27)  $t^6 \div t^8$

28)  $\frac{e^9}{e^2}$

29)  $\frac{w^{11}}{w^7}$

30)  $\frac{j^{18}}{j^{13}}$

31)  $\frac{e^9 \times e^8}{e^{12}}$

32)  $\frac{a^{12} \times a^7}{a^2}$

33)  $\frac{y^{17} \times y^5}{y^2 \times y^2}$

34)  $\frac{h^{35} \times h^8}{h^9 \times h^{11}}$

35)  $15f^{15} \div 5f^6$

36)  $18n^{18} \div 3n^6$

37)  $24v^{21} \div 6v^{13}$

38)  $30g^4 \div 5g^7$

39)  $32r^{16} \div 8s^{15}$

40)  $24x^5y^4 \div 6xy^2$

41)  $\frac{35a^{28}}{7a^3}$

42)  $\frac{16k^{11}}{8k^7}$

43)  $\frac{18a^6b^{11}}{6a^3b}$

44)  $(e^3)^5$

45)  $(c^4)^3$

46)  $(y^7)^4$

47)  $(j^4)^9$

48)  $(a^4)^8$

49)  $(t^4)^2$

50)  $(x^3y^4)^3$

51)  $(2j^7)^5$

52)  $(5y^9)^3$

53)  $(3k^8)^4$

54)  $(4y^{11})^3$

55)  $(10a^3b^4)^5$

56)  $(5e^4f^9)^2$

57)  $(3a^7b^5)^3$

58)  $(4h^7i^3)^2$

### Example Questions Expanding brackets

HINT

+ X + = +

- X - = +

- X + = -

+ X - = -

A) Expand:

1)  $8(2a + 1) = 16a + 8$

2)  $3(4e - 1) = 12e - 3$

3)  $4a(a - 2) = 4a^2 - 8a$

4)  $3x(2x + y) = 6x^2 + 3xy$

B) Expand and simplify:

$$1) 3(4a + 2) + 5(a - 1)$$

$$= 12a + 6 + 5a - 5$$

$$= 17a + 1$$

$$2) 9(8e + 2) - 2(3e - 5)$$

$$= 72e + 18 - 6e + 10$$

$$= 66e + 28$$

3)  $(c + 4)(c + 8)$

X	c	+4
c	$c^2$	$+4c$
+8	$+8c$	$+32$

$$= \frac{c^2 + 12c + 32}{1}$$

4)  $(d + 3)(d - 5)$

X	d	+3
d	$d^2$	$+3d$
-5	$-5d$	$-15$

$$= \underline{d^2 - 2d - 15}$$

<p>5) <math>(w - 2)(w + 2)</math></p> <table border="1" style="border-collapse: collapse; margin-bottom: 10px;"> <tr><td style="padding: 5px;">X</td><td style="padding: 5px;">w</td><td style="padding: 5px;">-2</td></tr> <tr><td style="padding: 5px;">w</td><td style="padding: 5px;"><math>w^2</math></td><td style="padding: 5px;"><math>-2w</math></td></tr> <tr><td style="padding: 5px;">+2</td><td style="padding: 5px;"><math>+2w</math></td><td style="padding: 5px;">-4</td></tr> </table> <p><math>= w^2 - 4</math></p> <p>7) <math>(2w - 1)(w + 4)</math></p> <table border="1" style="border-collapse: collapse; margin-bottom: 10px;"> <tr><td style="padding: 5px;">X</td><td style="padding: 5px;">2w</td><td style="padding: 5px;">-1</td></tr> <tr><td style="padding: 5px;">w</td><td style="padding: 5px;"><math>2w^2</math></td><td style="padding: 5px;"><math>-w</math></td></tr> <tr><td style="padding: 5px;">+4</td><td style="padding: 5px;"><math>+8w</math></td><td style="padding: 5px;">-4</td></tr> </table> <p><math>= 2w^2 + 7w - 4</math></p>	X	w	-2	w	$w^2$	$-2w$	+2	$+2w$	-4	X	2w	-1	w	$2w^2$	$-w$	+4	$+8w$	-4	<p>6) <math>(k - 3)(k - 6)</math></p> <table border="1" style="border-collapse: collapse; margin-bottom: 10px;"> <tr><td style="padding: 5px;">X</td><td style="padding: 5px;">k</td><td style="padding: 5px;">-3</td></tr> <tr><td style="padding: 5px;">k</td><td style="padding: 5px;"><math>k^2</math></td><td style="padding: 5px;"><math>-3k</math></td></tr> <tr><td style="padding: 5px;">-6</td><td style="padding: 5px;"><math>-6k</math></td><td style="padding: 5px;">+18</td></tr> </table> <p><math>= k^2 - 9k + 18</math></p> <p>8) <math>(3a + 2b)^2 = (3a + 2b)(3a + 2b)</math></p> <table border="1" style="border-collapse: collapse; margin-bottom: 10px;"> <tr><td style="padding: 5px;">X</td><td style="padding: 5px;">3a</td><td style="padding: 5px;">+2b</td></tr> <tr><td style="padding: 5px;">3a</td><td style="padding: 5px;"><math>9a^2</math></td><td style="padding: 5px;"><math>+6ab</math></td></tr> <tr><td style="padding: 5px;">+2b</td><td style="padding: 5px;"><math>+6ab</math></td><td style="padding: 5px;">+4b<sup>2</sup></td></tr> </table> <p><math>= 9a^2 + 12ab + 4b^2</math></p>	X	k	-3	k	$k^2$	$-3k$	-6	$-6k$	+18	X	3a	+2b	3a	$9a^2$	$+6ab$	+2b	$+6ab$	+4b <sup>2</sup>
X	w	-2																																			
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X	3a	+2b																																			
3a	$9a^2$	$+6ab$																																			
+2b	$+6ab$	+4b <sup>2</sup>																																			

A) Expand:

1)  $5(p + 3)$

2)  $7(y - 2)$

3)  $2(h - 9)$

4)  $6(2e - 1)$

5)  $9(4p + 3)$

6)  $2(5j - 2)$

7)  $e(e + 2)$

8)  $p(p - 3)$

9)  $k(k + 8)$

10)  $2y(y - 1)$

11)  $3b(b + 5)$

12)  $7m(2m + 9)$

13)  $3a(10 - 3a)$

14)  $-4(2v - 1)$

15)  $-5(19 - 4a)$

16)  $4ab(2a + b)$

17)  $3ef(3e + 2f)$

18)  $9ab(2b - 5a)$

19)  $2a(3a + b - 5)$

20)  $3e^2f(7e - f + 3)$

B) Expand and simplify:

1)  $4(a + 3) + 2(a + 1)$

2)  $5(p + 5) + 2(p + 3)$

3)  $2(3a + 2b) + 6(2a + b)$

4)  $4(9i + 2) - 3(2i + 5)$

5)  $5(4 - 3y) + 8(2y - 1)$

6)  $6(5t + 1) - 3(2t - 1)$

7)  $3(4c + 7) - 4(12 - 3c)$

8)  $8(3w - 1) - 3(5 - 4w)$

9)  $2a(3a + b) - 2(a - 2b)$

10)  $6y(5y - 2) - 5(9 - 2y)$

11)  $(h + 3)(h + 2)$

12)  $(e + 9)(e + 2)$

13)  $(7 + a)^2$

14)  $2(f + 5)^2$

15)  $(x + 3)(x - 6)$

16)  $(9 + e)(e - 2)$

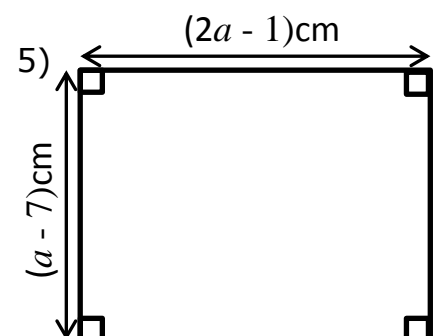
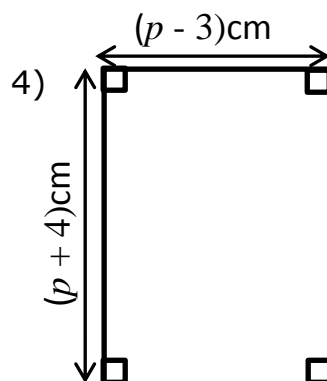
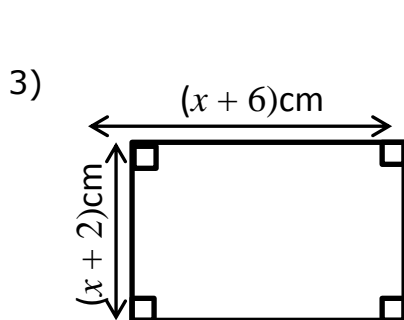
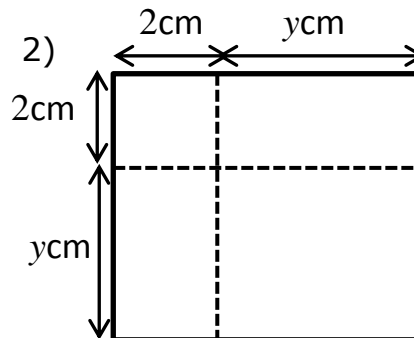
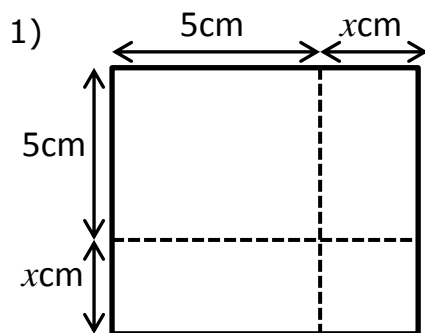
17)  $(w - 5)(w + 5)$

18)  $(y - 9)(y - 3)$

19)  $(3a - 2)(a + 3)$

20)  $(2b - 7)^2$

C) Write an expression for the area of each of the shapes below:



## Example Questions Factorising Expressions

**HINT**  
Check there is nothing in common in the bracket

**HINT**  
Find the HCF of the terms.

Simplify:

$$(a) 4a + 8 = 4(a + 2)$$

$$(b) ab + b = b(a + 1)$$

$$(c) 12ef - 8f = 4f(3e - 2)$$

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

$$(e) 9a^2b - 12ab^3 = 3ab(3a - 4b^2)$$

$$(f) 7(w + 1)^2 + 2(w + 1)$$

$$= 7(w + 1)(w + 1) + 2(w + 1)$$

$$= (w + 1)(7(w + 1) + 2) = (w + 1)(7w + 7 + 2)$$

$$= (w + 1)(7w + 9)$$

$$(g) x^2 + 10x + 16$$

1 × 16
2 × 8
4 × 4

$$(x + 2)(x + 8)$$

$$(h) x^2 - 9x + 14$$

$$(x - 2)(x - 7)$$

$$(i) x^2 - 9$$

$$(x - 3)(x + 3)$$

$$(j) x^2 + x - 12$$

$$(x + 4)(x - 3)$$

**HINT**  
Check your answer is correct by expanding your bracket.

**HINT**  
If this number is positive the signs in the brackets are the same.

**HINT**  
T IMES  
E ND  
A DD  
M IDdle

Factorise the following expressions:

1)  $6y + 12$

2)  $5k + 15$

3)  $20 + 10m$

4)  $2f - 4$

5)  $9i - 45$

6)  $25 - 5k$

7)  $ef + fg$

8)  $cd - d$

9)  $7abc + 5bc$

10)  $a^2 + 9a$

11)  $4y^2 - y$

12)  $p^2 - 3p$

13)  $2ab + 6bc$

14)  $8ef - 20f$

15)  $16xy + 40wy$

16)  $15a + 10ab$

17)  $24ef - 16e$

18)  $18a^2 - 24ab^2$

19)  $20b^2 + 35bc$

20)  $9a^2b + 12ac$

21)  $48k^2 - 16kj^2$

22)  $8(p + 5)^2 - 3(p + 5)$

23)  $5(f - 2)^2 + 2(f - 2)$

24)  $7(y - 3) - 2(y - 3)^2$

25)  $6(5 - k)^2 + 4(5 - k)$

26)  $x^2 + 8x + 12$

27)  $x^2 + 11x + 18$

28)  $x^2 + 7x + 10$

29)  $x^2 - 12x + 20$

30)  $x^2 - 10x + 25$

31)  $x^2 - 9x + 14$

32)  $x^2 - 49$

33)  $x^2 - 100$

34)  $x^2 - 144$

35)  $x^2 - 2x - 35$

36)  $x^2 + 5x - 14$

37)  $x^2 - x - 20$

Solve:

## Example Questions Solving Linear Equations

Solve:

(a)  $8e + 19 = 59$

$$\begin{array}{r} -19 \quad -19 \\ 8e = 40 \div 8 \\ \boxed{e = 5} \end{array}$$

(c)  $7k - 9 = 11$

$$\begin{array}{r} +9 \quad +9 \\ 7k = 20 \div 7 \\ \boxed{k = \frac{20}{7}} \end{array}$$

(e)  $10 - 2e = 22$

$$\begin{array}{r} +2e \quad +2e \\ 10 = 2e + 22 \\ -22 \quad -22 \\ -12 = 2e \div 2 \\ \boxed{e = -6} \end{array}$$

(g)  $7p + 19 = 3p + 43$

$$\begin{array}{r} -3p \quad -3p \\ 4p + 19 = 43 \\ -19 \quad -19 \\ 4p = 24 \\ \boxed{p = 6} \end{array}$$

(i)  $3(4a - 1) = 5(a + 5)$

$$\begin{array}{r} 12a - 3 = 5a + 25 \\ 7a - 3 = 25 \\ 7a = 28 \\ \boxed{a = 4} \end{array}$$

(k)  $\frac{3x-4}{5} = 4$

$$\begin{array}{r} \times 5 \quad \times 5 \\ 3x - 4 = 20 \\ 3x = 24 \\ \boxed{x = 8} \end{array}$$

(b)  $9y - 11 = 16$

$$\begin{array}{r} +11 \quad +11 \\ 9y = 27 \div 9 \\ \boxed{y = 3} \end{array}$$

(d)  $8k + 14 = 6$

$$\begin{array}{r} -14 \quad -14 \\ 8k = -8 \div 8 \\ \boxed{k = -1} \end{array}$$

(f)  $5(2a - 3) = 15$

$$\begin{array}{r} 10a - 15 = 15 \div 5 \\ +15 \quad +15 \\ 10a = 30 \div 10 \\ \boxed{a = 3} \end{array}$$

(h)  $20 - 3x = 2x - 25$

$$\begin{array}{r} +3x \quad +3x \\ 20 = 5x - 25 \\ 45 = 5x \\ \boxed{x = 9} \end{array}$$

(j)  $\frac{3y}{2} = 15$

$$\begin{array}{r} \times 2 \quad \times 2 \\ 3y = 30 \\ \boxed{y = 10} \end{array}$$

(l)  $\frac{5a}{3} + 2 = 9$

$$\begin{array}{r} -2 \quad -2 \\ \frac{5a}{3} = 7 \\ \times 3 \quad \times 3 \\ 5a = 21 \\ \boxed{a = \frac{21}{5}} \end{array}$$

Solve:

1)  $3e - 8 = 10$

2)  $6k + 13 = 37$

3)  $7a + 19 = 40$

4)  $18 - 3y = 6$

5)  $29 = 15 - 2w$

6)  $36 = 2(3 - 5k)$

7)  $6i - 10 = 23$

8)  $2(4w - 1) = 9$

9)  $27 = 3(3 - 2x)$

10)  $6r + 9 = 8r - 19$

11)  $10w + 11 = 3w - 4$

12)  $3(4f - 5) = 2f + 25$

13)  $5x - 6 = 3(x - 1)$

14)  $\frac{2-y}{5} = 1$

15) Solve  $\frac{5-x}{2} = 2x - 7$

16) Solve  $\frac{4(8x-2)}{3x} = 10$

## Example Questions

### Forming and solving equations

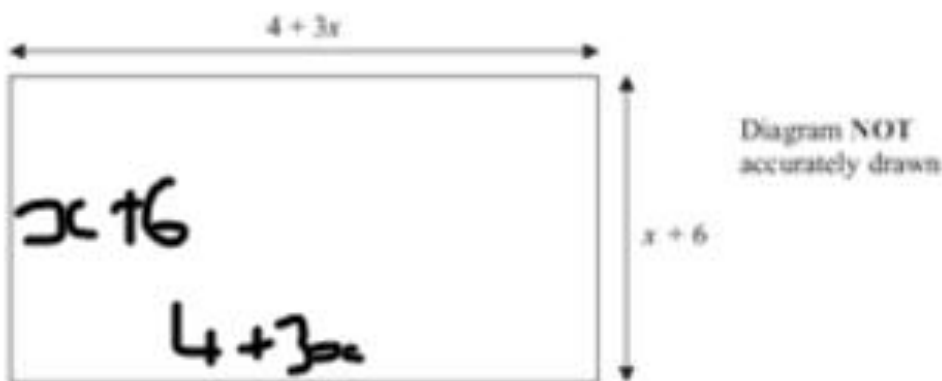
- 1) Ali is  $y$  years old.  
 Bhavara is twice as old as Ali.  
 Ceris is 3 years younger than Ali.  
 The total of their ages is 125 years.  
 Work out the age of each person.

$$\begin{array}{ccc} A & B & C \\ y & 2y & y-3 \\ y+2y+y-3 & = & 4y-3 \end{array}$$

$$\begin{array}{r} 4y - 3 = 125 \\ +3 \quad \quad +3 \\ \hline 4y = 128 \\ \div 4 \quad \quad \div 4 \\ \hline y = 32 \end{array}$$

Ali 32 years  
 Bhavara 64 years  
 Ceris 29 years

- 2) The diagram shows a garden in the shape of a rectangle.



- All measurements are in metres.  
 The perimeter of the garden is 32 metres.  
 Work out the value of  $x$

$$4 + 3x + 4 + 3x + x + 6 + x + 6$$

$$\begin{array}{r} 32 = 8x + 20 \\ -20 \quad -20 \\ \hline 12 = 8x \\ \div 8 \quad \div 8 \\ \hline 1.5 = x \end{array}$$

$$\frac{12}{8} = x$$

$$\frac{3}{2} = x$$

1) Kiaria is 7 years older than Jay.  
Martha is twice as old as Kiaria.  
The sum of their three ages is 77  
Find the ratio of Jay's age to Kiaria's age to Martha's age.

2) The diagram shows a trapezium.

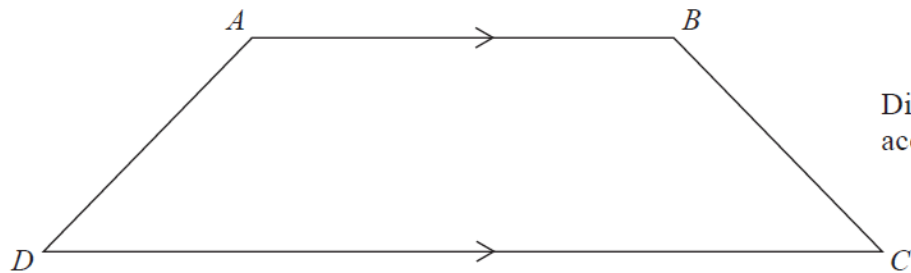


Diagram **NOT**  
accurately drawn

$AD = x$  cm.  
 $BC$  is the same length as  $AD$ .  
 $AB$  is twice the length of  $AD$ .  
 $DC$  is 4 cm longer than  $AB$ .

The perimeter of the trapezium is 38 cm.

Work out the length of  $AD$ .

3)

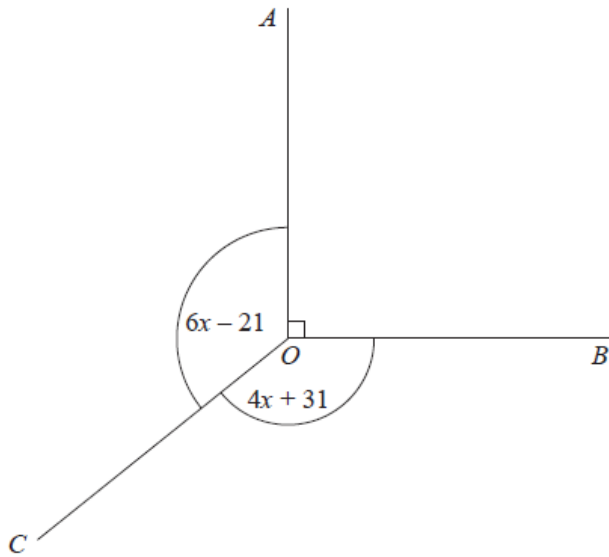


Diagram NOT  
accurately drawn

In the diagram, all angles are in degrees.  
Angle  $AOB$  is a right angle.  
Angle  $AOC =$  Angle  $BOC$ .  
Work out the value of  $x$ .

4)  $ABC$  is a triangle.

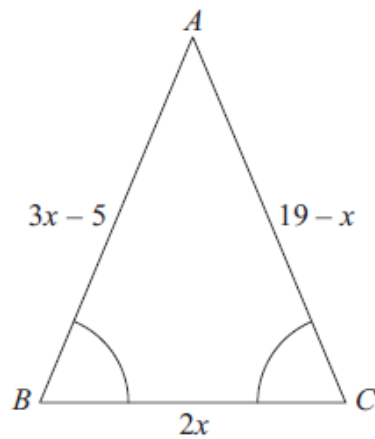
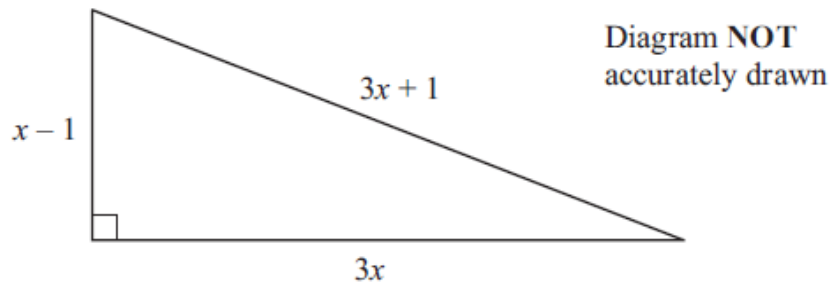


Diagram NOT  
accurately drawn

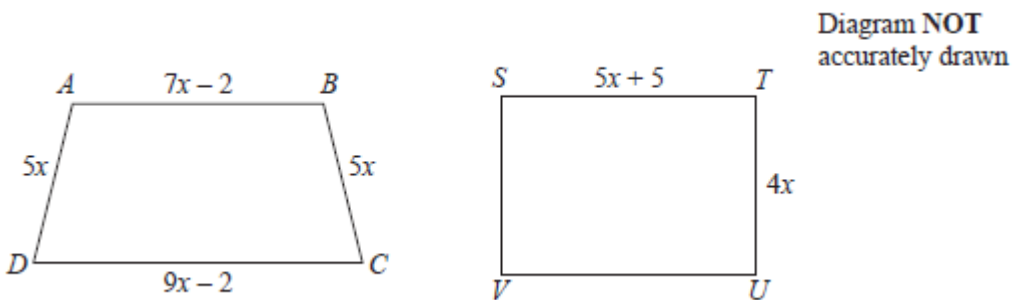
Angle  $ABC =$  angle  $BCA$ .  
The length of side  $AB$  is  $(3x - 5)$  cm.  
The length of side  $AC$  is  $(19 - x)$  cm.  
The length of side  $BC$  is  $2x$  cm.  
Work out the perimeter of the triangle.  
Give your answer as a number of centimetres.

5) The diagram shows a triangle.



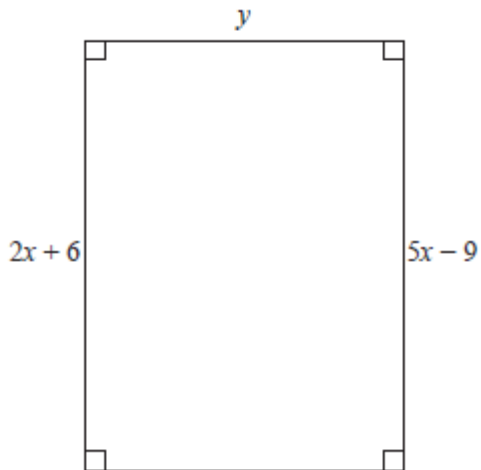
In the diagram, all the measurements are in metres.  
The perimeter of the triangle is 56 m.  
The area of the triangle is  $A \text{ m}^2$ .  
Work out the value of  $A$ .

6)  $ABCD$  is a trapezium.  
 $STUV$  is a rectangle.



All measurements are in centimetres.  
The two shapes have the same perimeter.  
Work out the length of  $ST$ .

7) Here is a rectangle.

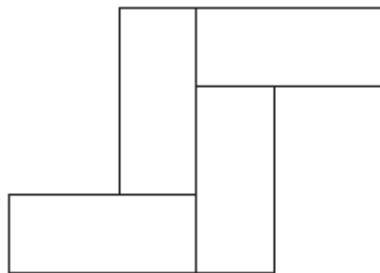


All measurements are in centimetres.  
The area of the rectangle is  $48 \text{ cm}^2$ .  
Show that  $y = 3$

8) Here is a rectangle.



The length of the rectangle is 7 cm longer than the width of the rectangle.  
4 of these rectangles are used to make this 8-sided shape.



The perimeter of the 8-sided shape is 70 cm.  
Work out the area of the 8-sided shape.

## Example Questions

### Rearranging formulae

HINT  
Make everything equal to p

1)  $w = 4p - 16$

Make  $p$  the subject of this formula.

$$w + 16 = 4p \quad \div 4 \quad \boxed{p = \frac{w + 16}{4}}$$

2) Make  $p$  the subject of the formula

$y = 3p^2 - 4$

$$y + 4 = 3p^2 \quad \div 3 \quad \sqrt{\frac{y + 4}{3}} = p \quad \sqrt{\phantom{x}}$$

$$\boxed{\sqrt{\frac{y + 4}{3}} = p}$$

3)

$m = \sqrt{\frac{k + 1}{4}}$

Make  $k$  the subject of the formula.

$$m^2 = \frac{k + 1}{4} \quad \times 4 \quad 4m^2 = k + 1 \quad -1 \quad \boxed{k = 4m^2 - 1}$$

4) Make  $s$  the subject of  $v^2 = u^2 + 2as$

$$v^2 - u^2 = 2as \quad \div 2a \quad s = \frac{v^2 - u^2}{2a}$$

A) Make **a** the subject of the formula.

1)  $b = a + 3$

2)  $k = 5 + a$

3)  $a - 6 = t$

4)  $f = a + 2e$

5)  $j = 4y + a$

6)  $r = a - 9b$

7)  $a - 5h = 3b$

8)  $a + 3ef = 2$

9)  $3w = a - 8p$

10)  $5 + f = a - 4e$

11)  $\frac{a}{3} = b$

12)  $\frac{a}{y} = 4$

13)  $\frac{a}{5b} = 2$

14)  $3e = \frac{a}{11}$

15)  $2c = \frac{a}{3b}$

16)  $y = a^2$

17)  $a^2 = e + 5$

18)  $a^2 + 5 = b$

19)  $a^2 - b = 2c$

20)  $\sqrt{a} = y$

21)  $h = \sqrt{a}$

22)  $e = \sqrt{a}$

23)  $\sqrt{a} = I$

24)  $\sqrt{a} = k$

B) Make **w** the subject of the formula.

1)  $y = 2w + 5$

2)  $e + f = 3w + g$

3)  $k - i = 9 + 4w$

4)  $7w + 4 = 5e$

5)  $8w - 7 = e + f$

6)  $e = 5w + 11$

7)  $6y + 3 = 5w$

8)  $3k = 3w + 9$

9)  $7 + 8u = 3w + y$

10)  $9bw - y = 2e + f$

11)  $10 - 2w = 3a$

12)  $7b = 9 - 3w$

13)  $5e + f = a - 6w$

14)  $4u - 3w = 2a - b$

15)  $10 - 2aw = 5b$

16)  $a + 2ew = 8b + 3$

17)  $\frac{2w}{5} = y$

18)  $\frac{5w}{2} = a$

19)  $\frac{9w}{b} = a$

$$20) 3e = \frac{3w}{7}$$

$$21) 5a = \frac{8w}{b}$$

$$22) \frac{6w}{ab} = 5$$

$$23) \frac{3}{6w} = y$$

$$24) 5a = \frac{8w}{b}$$

$$25) 3 = \frac{6a}{5aw}$$

C) Make **e** the subject of the formula.

$$1) e^2 = 3a + b$$

$$2) a = e^2 + 5b$$

$$3) 3 = a + e^2$$

$$4) v = e^2 - 9$$

$$5) 7 + e^2 = 2k$$

$$6) 2a - e^2 = 9$$

$$7) 2b = 3a - e^2$$

$$8) 6 - e^2 = 7a$$

$$9) 3aw + 5e^2 = 8$$

$$10) 10 - 3e^2 = 7a$$

$$11) 9e^2 + b = 10$$

$$12) k - 3e^2 = a + b$$

$$13) \sqrt{e} = 4a + 5$$

$$14) 5 + \sqrt{e} = 2p$$

$$15) 8u + \sqrt{e} = 9a + 10u$$

$$16) \sqrt{e+5} = 4a$$

$$17) 2a + b = \sqrt{7e}$$

$$18) \sqrt{5e} = 9a + 2$$

$$19) \sqrt{9e} = 7f + 1$$

$$20) 8i - 3 = \sqrt{3e}$$

$$21) 4j + 8 = \sqrt{3e-1}$$

$$22) \frac{\sqrt{e}}{3} = a$$

$$23) \frac{\sqrt{4e}}{5} = 9w$$

$$24) \frac{\sqrt{2e+3}}{b} = 4$$

25) Make  $t$  the subject of the formula  $2(t-5) = y$

26) Make  $q$  the subject of the formula  $P = 2q + 10$

27) When you are  $h$  feet above sea level, you can see  $d$  miles to the horizon, where  $d = \sqrt{\frac{3h}{2}}$   
Make  $h$  the subject of the formula.

28) Rearrange  $a(q-c) = d$  to make  $q$  the subject.

## Example Questions

### Sequences

1) Find the next three terms of the following Fibonacci-style sequence.

2, 2, 4, 6, 10, ...

$$6 + 10 = 16 \quad 10 + 16 = 26 \quad 16 + 26 = 42$$

2) Here are the first 5 terms of an arithmetic sequence.

$$\boxed{5n} \quad 5 \quad 10 \quad 15 \quad 20 \quad 25$$

6, 11, 16, 21, 26

Find an expression, in terms of  $n$ , for the  $n$ th term of the sequence.

$$\boxed{5n + 1}$$

3) The first four terms of an arithmetic sequence are

$$\begin{array}{cccc} -4 & -4 & -4 & -4 \\ 21 & 17 & 13 & 9 \end{array}$$

Find, in terms of  $n$ , an expression for the  $n$ th term of this sequence.

$$\boxed{\begin{array}{c} -4n + 25 \\ \text{or} \\ 25 - 4n \end{array}}$$

The  $n$ th term of a sequence is  $2n^2$

(i) Find the 4th term of the sequence.

$$2 \times 4 \times 4$$

$$\boxed{= 32}$$

(ii) Is the number 400 a term of the sequence?

Give reasons for your answer.

$$400 \div 2 = 200$$

No, because 200 is not a square number.

A) Find the next three terms of the following Fibonacci-style sequences

1) 1, 1, 2, 3, . . .

2) 3, 6, 9, 15, . . .

3) 4, 8, 12, 20, . . .

4) 15, 23, 38, 62, . . .

5) 5, 12, 17, 29, . . .

6) -3, 5, 2, 7, . . .

B) Find the  $n$ th term of the sequences below:

1) 6, 9, 12, 15

2) 5, 7, 9, 11

3) 4, 10, 16, 22

4) 10, 11, 12, 13

5) 2, 6, 10, 14

6) 1, 4, 7, 10

7) 10, 13, 16, 19

8) 2, 8, 14, 20

9) 9, 11, 13, 15

10) 5, 8, 11, 14

11) 9, 14, 19, 24

12) 3, 9, 15, 21

13) -3, 0, 3, 6

14) -6, 1, 8, 15

15) -9, -1, 7, 15

16) 10, 8, 6, 4

17) 7, 6, 5, 4

18) 15, 12, 9, 6

19) 19, 14, 9, 4

20) 14, 10, 6, 2

21) 20, 17, 14, 11

22) 18, 16, 14, 12

23) 21, 20, 19, 18

24) 38, 33, 28, 23

25) 16, 10, 4, -2

26) 17, 15, 13, 11

27) 28, 20, 12, 4

28) -3, -6, -9, -12

29) 2, -1, -4, -7

30) 10, 0, -10, -20

31) The  $n$ th term of a sequence is  $3n + 4$   
Explain why 21 is not a term of this sequence.

32) Here are the first four terms of an arithmetic sequence.

5 11 17 23

Write down an expression, in terms of  $n$ , for the  $n$ th term of the sequence.

33) Here are the first four terms of an arithmetic sequence.

11 17 23 29

(a) Find, in terms of  $n$ , an expression for the  $n$ th term of this arithmetic sequence.

(b) Is 121 a term of this arithmetic sequence?  
You must explain your answer.

34) Here are the first six terms of an arithmetic sequence.

3 8 13 18 23 28

(a) Find an expression, in terms of  $n$ , for the  $n$ th term of this sequence.

(b) The  $n$ th term of a different sequence is  $3n^2$   
Nathan says that the 4th term of this sequence is 144  
Is Nathan right?  
Show how you get your answer.

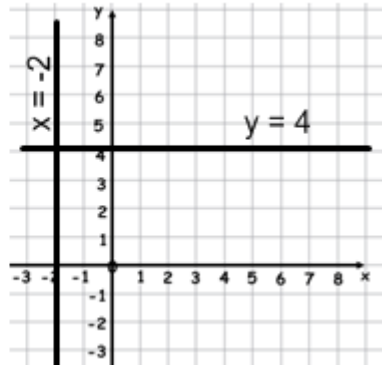
# Example Questions

## Linear Graphs

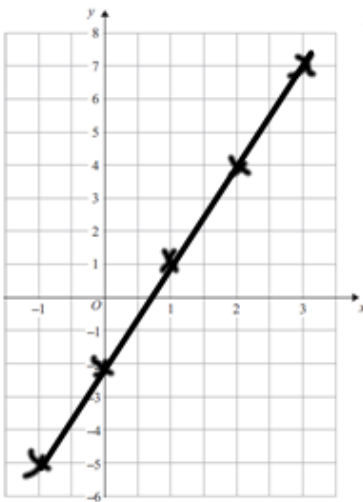
1) Plot the following lines on the graph.

a)  $y = 4$

b)  $x = -2$



2) On the grid, draw the graph of  $y = 3x - 2$  for values of  $x$  from  $-1$  to  $3$

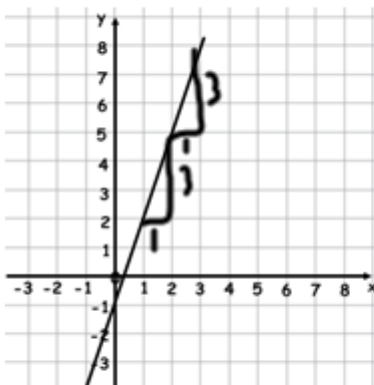


$y = 3x - 2$

$x$	-1	0	1	2	3
$y$	-5	-2	1	4	7

↑  
 $3 \times 3 - 2$

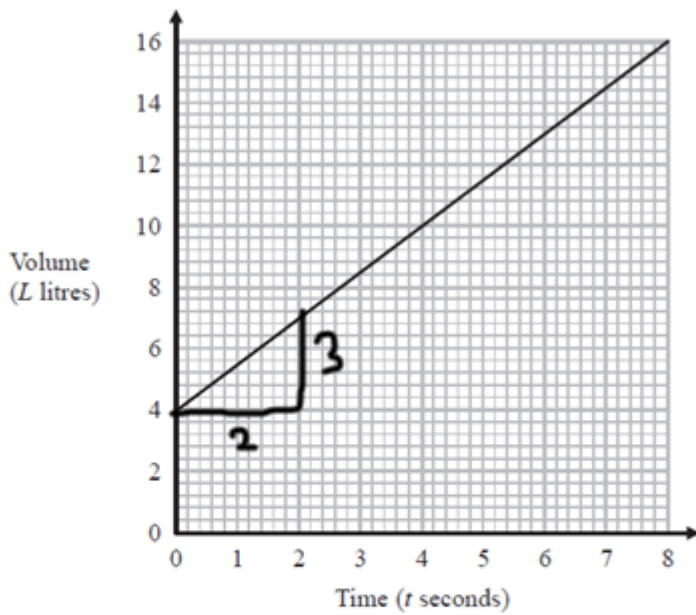
3) The line **J** is shown on the grid.



gradient
y-intercept  
 $y = mx + c$   
 $y = 3x - 1$

Find an equation for **J**.

The graph shows the volume of liquid ( $L$  litres) in a container at time  $t$  seconds.



(a) Find the gradient of the graph.

$$\text{Gradient} = \frac{\text{difference in } y}{\text{difference in } x} = \frac{3}{2} = 1.5$$

(b) Explain what this gradient represents.

The volume in litres per second

The graph intersects the volume axis at  $L = 4$

(c) Explain what this intercept represents.

The starting volume.

Complete the table of values and plot the graphs for each equation

1)  $y = x$

X	-3	-2	-1	0	1	2	3
y							

2)  $y = 2x$

X	-3	-2	-1	0	1	2	3
y							

3)  $y = 2x + 5$

X	-3	-2	-1	0	1	2	3
y							

4)  $y = 3x + 11$

X	-3	-2	-1	0	1	2	3
y							

5)  $y = 5x - 1$

X	-3	-2	-1	0	1	2	3
y							

6)  $y = 4x - 3$

X	-3	-2	-1	0	1	2	3
y							

7)  $y = 7x - 6$

X	-3	-2	-1	0	1	2	3
y							

8)  $y = 7x - 8$

X	-3	-2	-1	0	1	2	3
y							

Complete the table of values and plot the graphs for each equation

9)  $y = 8x$

X	-3	-2	-1	0	1	2	3
y							

10)  $y = 9x - 11$

X	-3	-2	-1	0	1	2	3
y							

11)  $y = 4x + 13$

X	-3	-2	-1	0	1	2	3
y							

12)  $y = 6x + 9$

X	-3	-2	-1	0	1	2	3
y							

13)  $y = 7x + 13$

X	-3	-2	-1	0	1	2	3
y							

14)  $y = 5x - 12$

X	-3	-2	-1	0	1	2	3
y							

15)  $y = 9x - 1$

X	-3	-2	-1	0	1	2	3
y							

16)  $y = 3x + 18$

X	-3	-2	-1	0	1	2	3
y							

Complete the table of values and plot the graphs for each equation

$$17) y = \frac{1}{2}x$$

X	-3	-2	-1	0	1	2	3
y							

$$18) y = \frac{1}{2}x + 18$$

X	-3	-2	-1	0	1	2	3
y							

$$19) y = \frac{1}{2}x + 5$$

X	-3	-2	-1	0	1	2	3
y							

$$20) y = \frac{1}{2}x - 2$$

X	-3	-2	-1	0	1	2	3
y							

$$21) y = \frac{1}{2}x + 6$$

X	-3	-2	-1	0	1	2	3
y							

$$22) y = -x$$

X	-3	-2	-1	0	1	2	3
y							

$$23) y = -2x$$

X	-3	-2	-1	0	1	2	3
y							

$$24) y = -3x$$

X	-3	-2	-1	0	1	2	3
y							

Complete the table of values and plot the graphs for each equation

25)  $y = -x + 4$

X	-3	-2	-1	0	1	2	3
y							

26)  $y = -2x + 8$

X	-3	-2	-1	0	1	2	3
y							

27)  $y = -3x + 15$

X	-3	-2	-1	0	1	2	3
y							

28)  $y = 10 - x$

X	-3	-2	-1	0	1	2	3
y							

29)  $y = 21 - x$

X	-3	-2	-1	0	1	2	3
y							

30)  $y = -3x + 3$

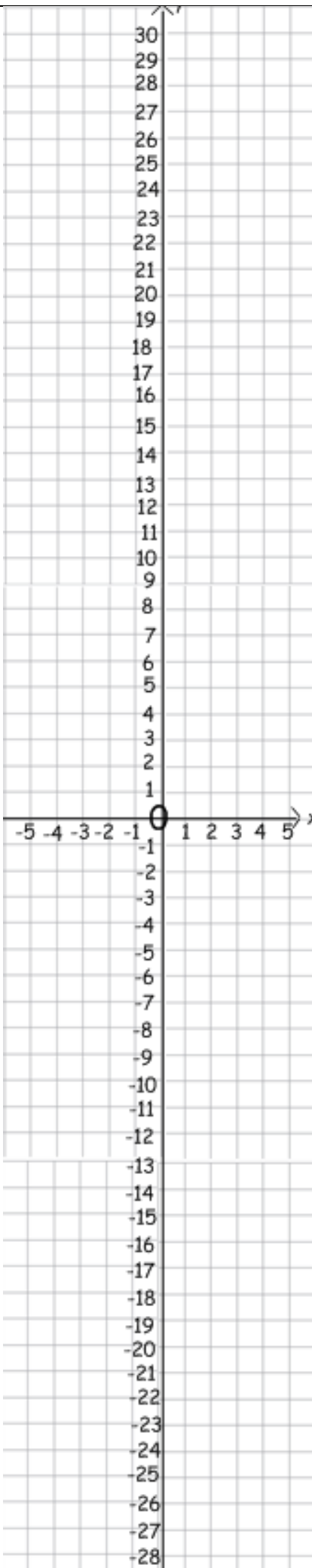
X	-3	-2	-1	0	1	2	3
y							

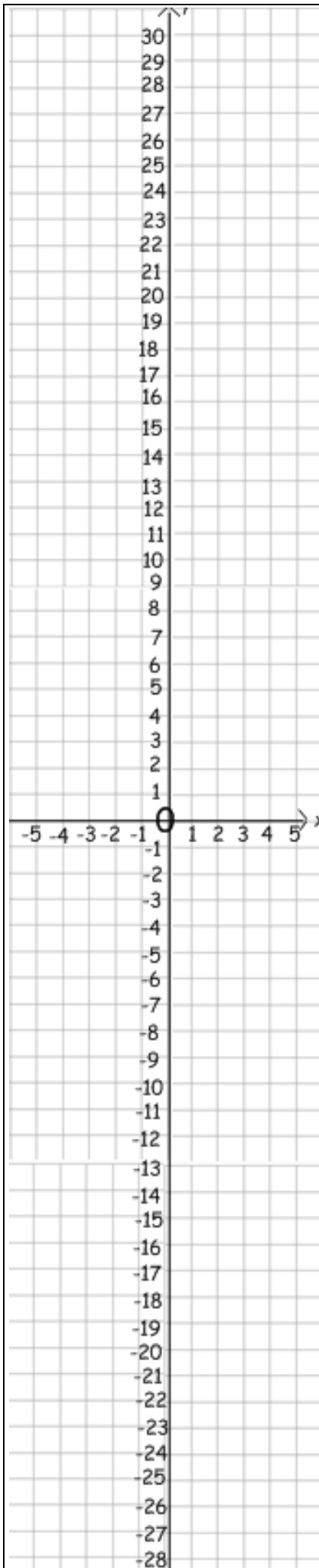
31)  $y = -5x - 1$

X	-3	-2	-1	0	1	2	3
y							

32)  $y = 18 - 2x$

X	-3	-2	-1	0	1	2	3
y							





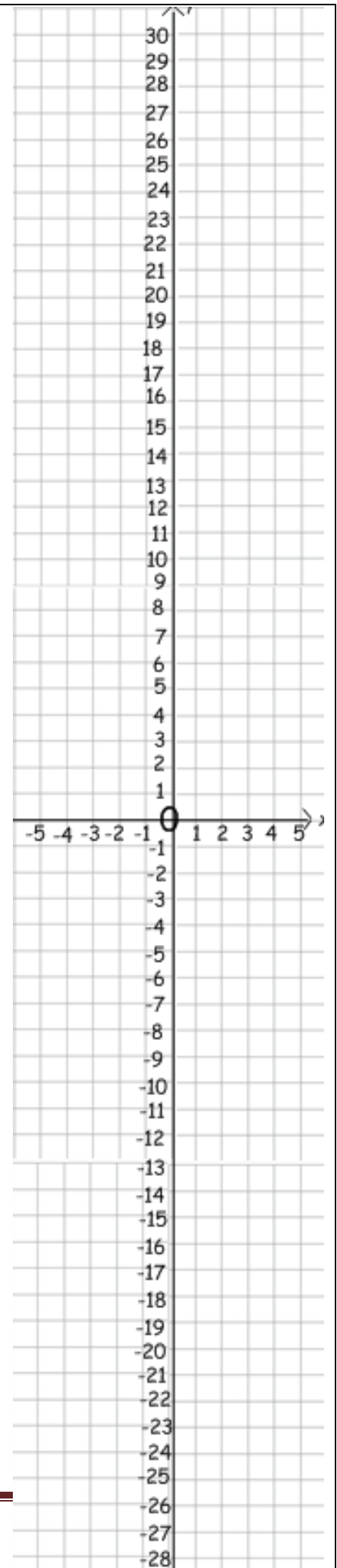
Without drawing a table of values, plot the graphs of the following equations.

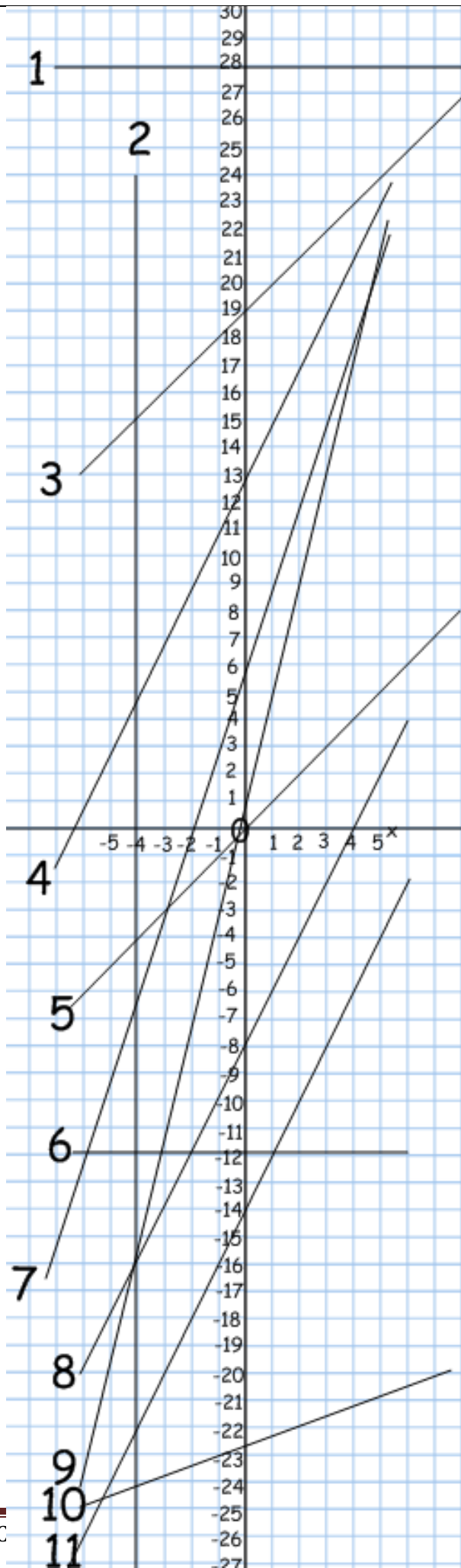
Plot these ones on the left:

- 1)  $y = 4x - 2$
- 2)  $y = 2x + 5$
- 3)  $y = x + 7$
- 4)  $y = 5x + 5$
- 5)  $y = 7x - 5$
- 6)  $y = \frac{1}{2}x - 2$
- 7)  $x = 5$
- 8)  $y = 10$
- 9)  $y = -10$
- 10)  $x = -2$

Plot these ones on the right:

- 11)  $y = -2x$
- 12)  $y = -3x + 1$
- 13)  $y = 5 - x$
- 14)  $y = 10 - 3x$
- 15)  $y = -5x + 1$
- 16)  $y = -3x + 19$
- 17)  $y = -6x - 3$
- 18)  $y = -\frac{1}{2}x - 5$
- 19)  $2x + 2y = 16$
- 20)  $9x + 6y = 24$

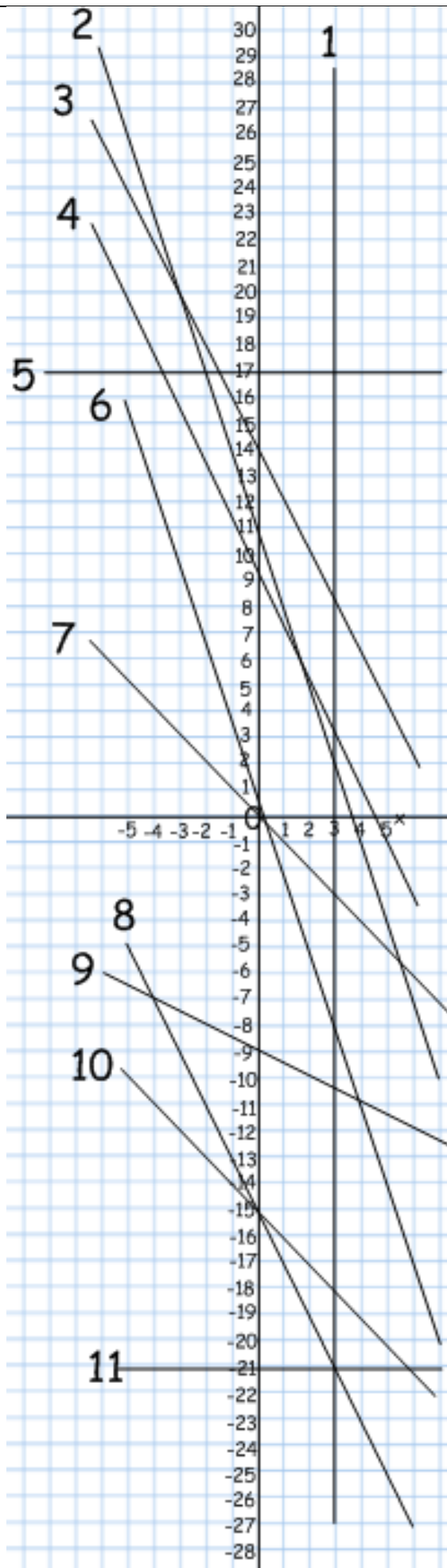




Write down the equation of each line in the form  $y = mx + c$ .

- 1)
- 2)
- 3)
- 4)
- 5)
- 6)
- 7)
- 8)
- 9)
- 10)
- 11)

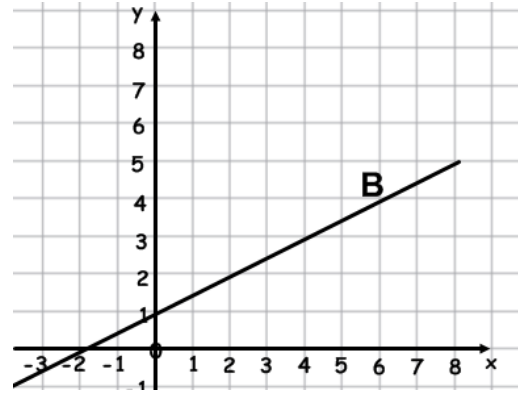
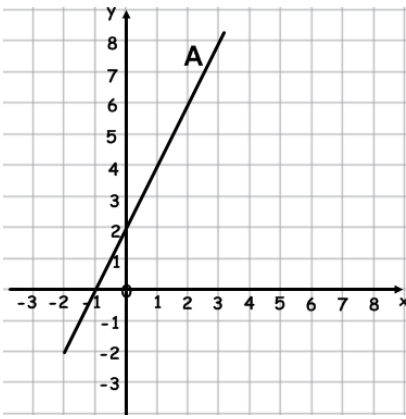
Which equations are parallel lines?



Write down the equation of each line in the form  $y = mx + c$ .

- 1)
- 2)
- 3)
- 4)
- 5)
- 6)
- 7)
- 8)
- 9)
- 10)
- 11)

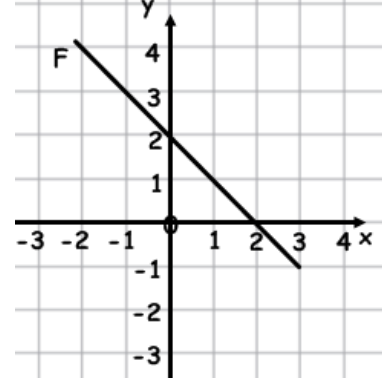
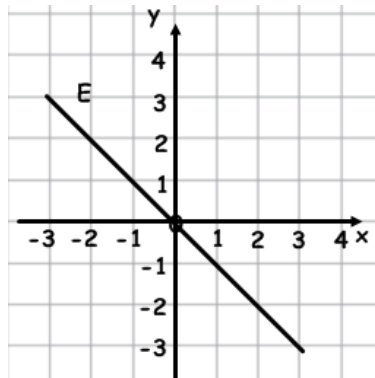
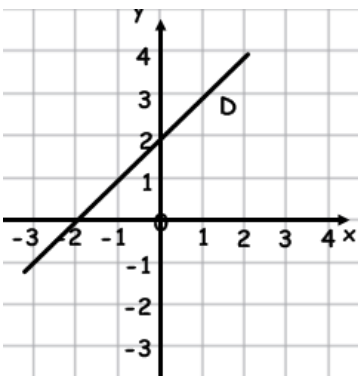
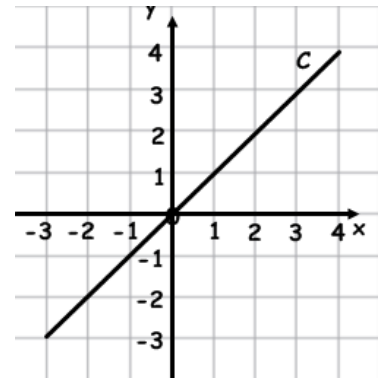
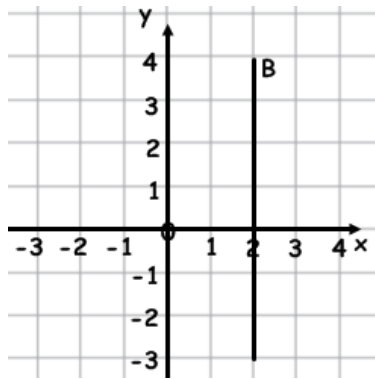
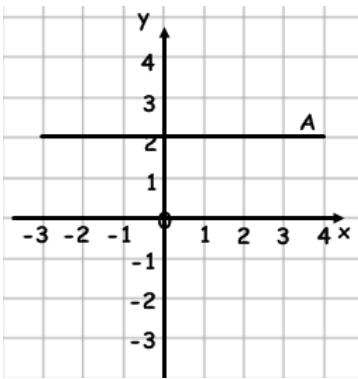
Which equations are parallel lines?



1) Find the equation of line A

2) Find the equation of line B.

3) Match the graphs to the correct equations.



Equation	Graph
$y = x$	
$y = 2$	
$y = x + 2$	
$x = 2$	
$y = -x$	
$y = 2 - x$	

# Example Questions

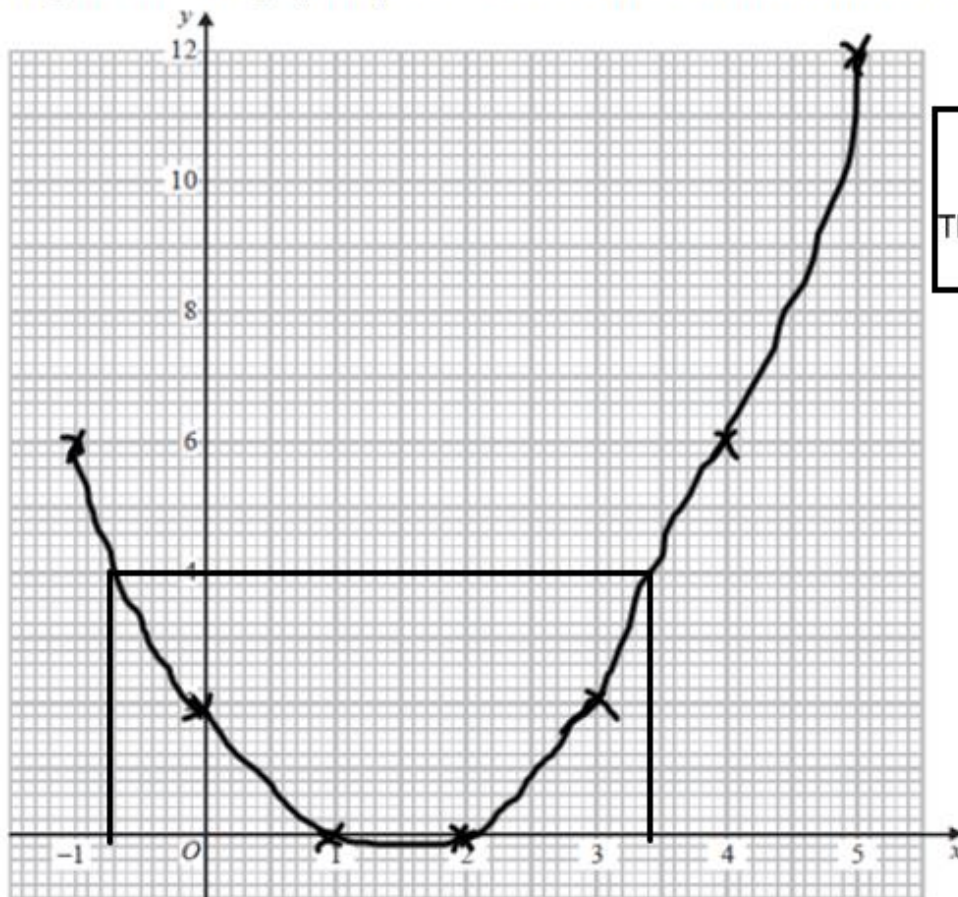
## Quadratic, cubic and reciprocal graphs

a) Complete the table of values for  $y = x^2 - 3x + 2$

$x$	-1	0	1	2	3	4	5
$y$	6	2	0	0	2	6	12

**HINT**  
 You can do this on your calculator.  
 Press mode, 3 and then enter the equation using the alpha button.

(b) On the grid, draw the graph of  $y = x^2 - 3x + 2$  for values of  $x$  from -1 to 5



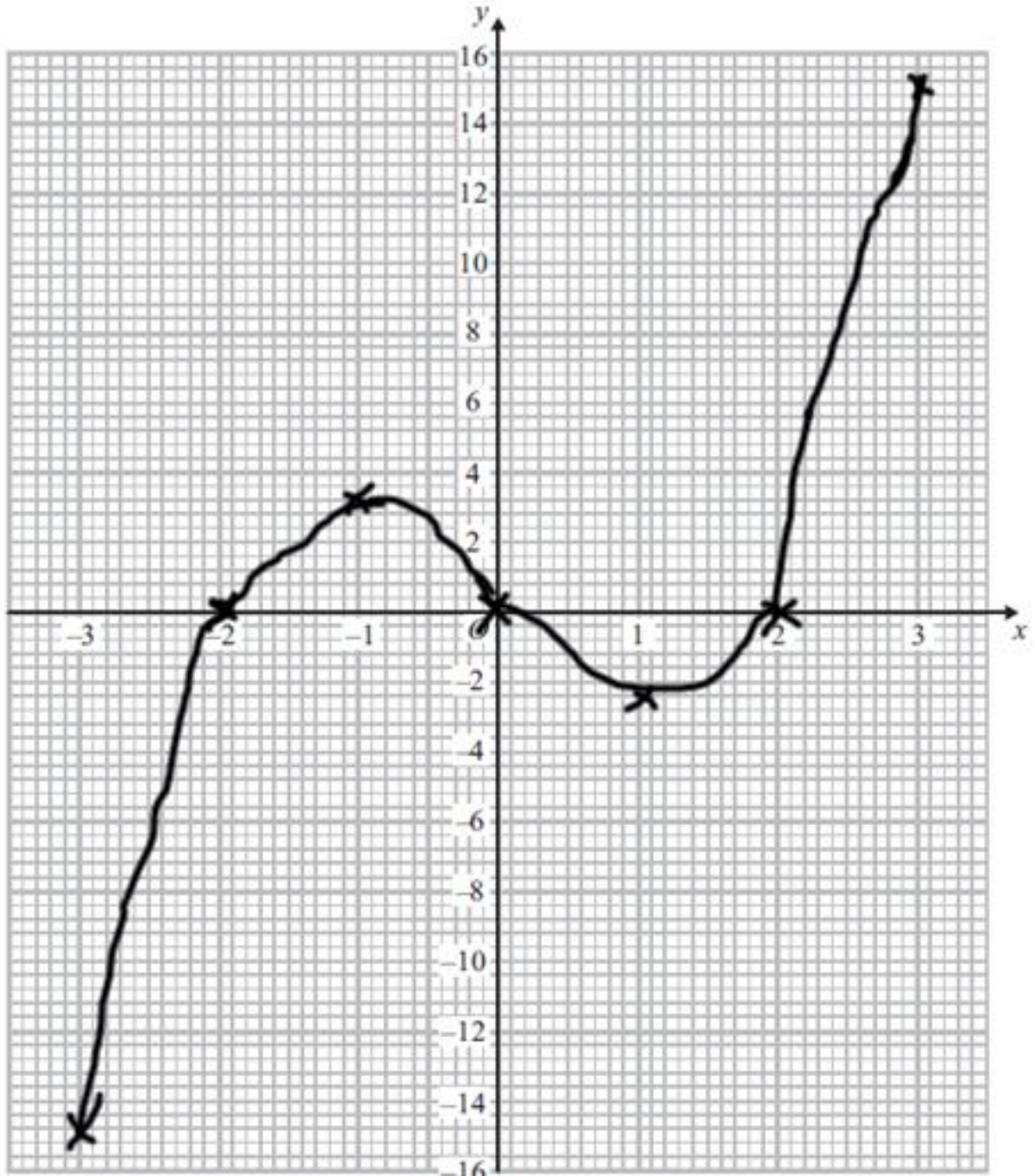
**HINT**  
 Do not use a ruler.  
 This should be a smooth curve.

(c) Find estimates for the solutions of the equation  $x^2 - 3x + 2 = 4$  —  $y = 4$   
 $x = -0.7$  or  $x = 3.4$

a) Complete the table of values for  $y = x^3 - 4x$

$x$	-3	-2	-1	0	1	2	3
$y$	-15	0	3	0	-3	0	15

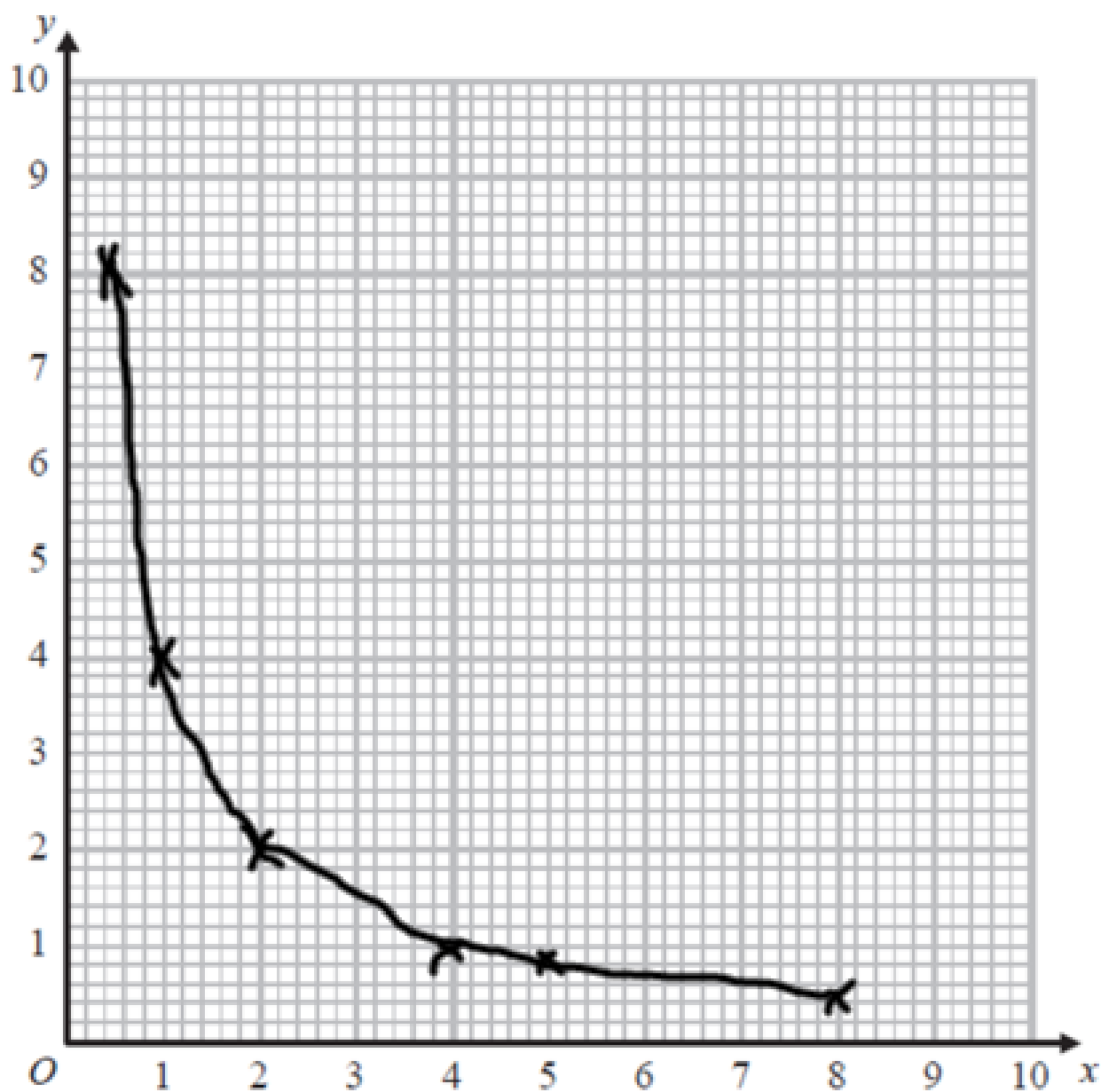
(b) On the grid, draw the graph of  $y = x^3 - 4x$  from  $x = -3$  to  $x = 3$



(a) Complete the table of values for  $y = \frac{4}{x} \leftarrow \div$

$x$	0.5	1	2	4	5	8
$y$	8	4	2	1	0.8	0.5

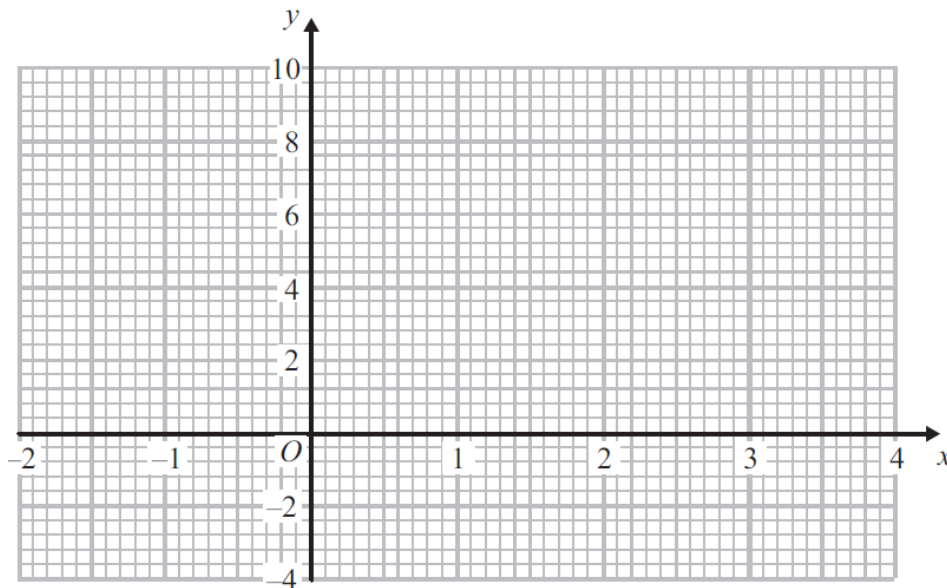
(b) On the grid, draw the graph of  $y = \frac{4}{x}$  for  $0.5 \leq x \leq 8$



(a) Complete the table of values for  $y = x^2 - 2x$

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

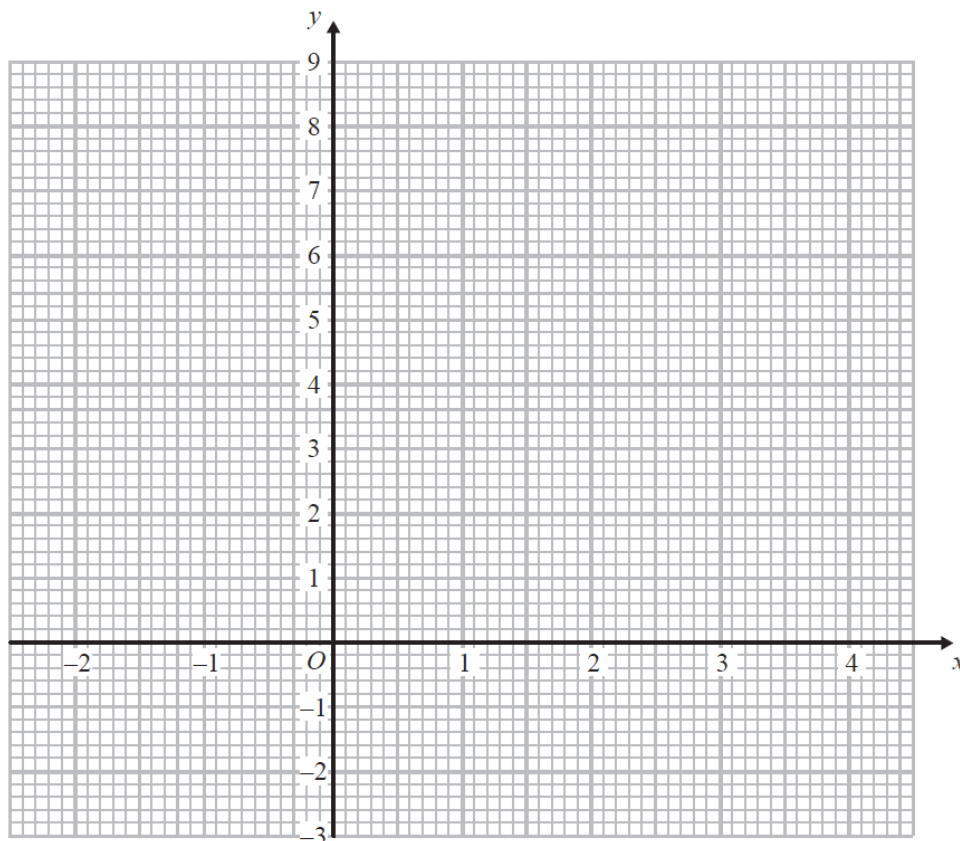
(b) On the grid, draw the graph of  $y = x^2 - 2x$  for values of  $x$  from -2 to 4



(a) Complete the table of values for  $y = x^2 - 2x - 1$ .

$x$	-2	-1	0	1	2	3	4
$y$	7			-2	-1		

(b) On the grid, draw the graph of  $y = x^2 - 2x - 1$  for values of  $x$  from -2 to 4.

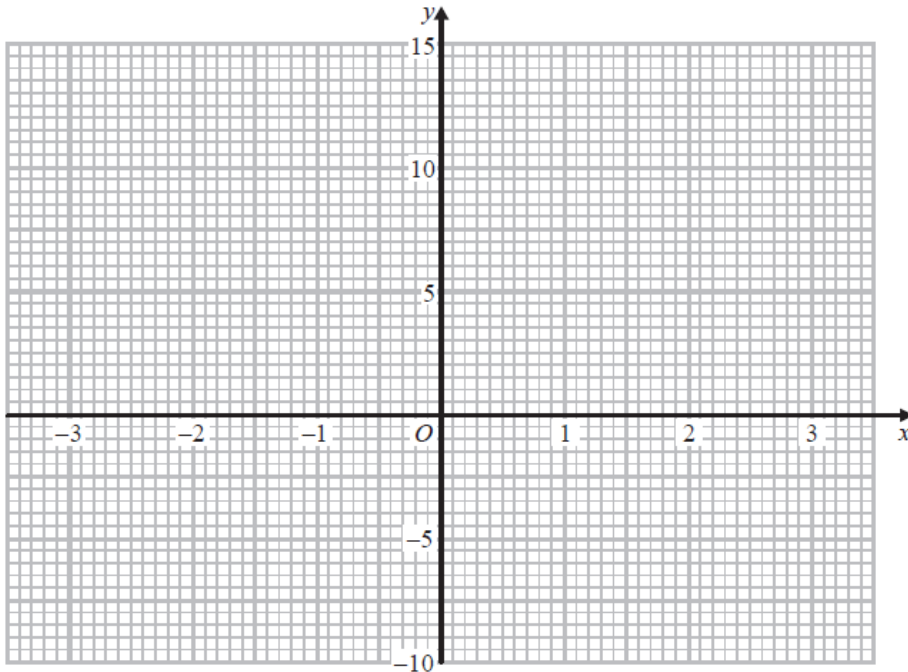


(c) Solve  $x^2 - 2x - 1 = x + 3$

(a) Complete this table of values for  $y = x^2 + x - 4$

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

(b) On the grid, draw the graph of  $y = x^2 + x - 4$  for values of  $x$  from  $-3$  to  $3$

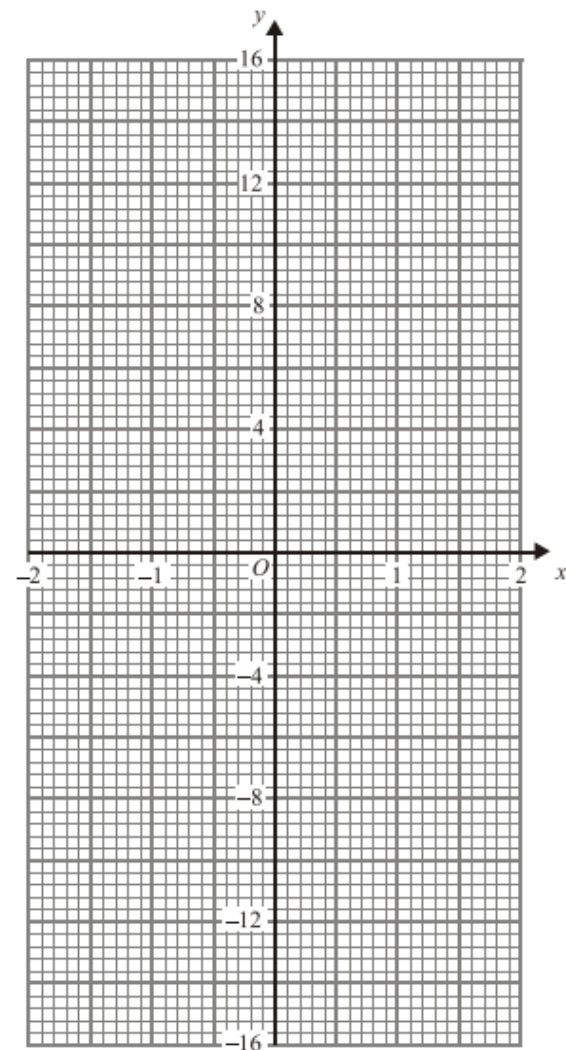


(c) Use the graph to estimate a solution to  $x^2 + x - 4 = 0$

(a) Complete the table of values for  $y = x^3 + 3x$

x	-2	-1	0	1	2
y					

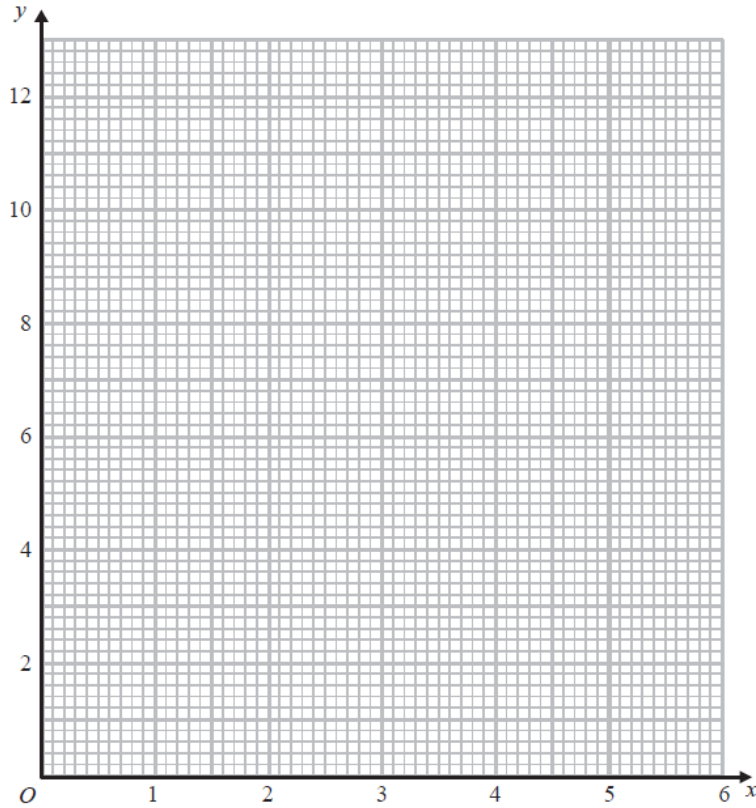
(b) On the grid, draw the graph of  $y = x^3 + 3x$



(a) Complete the table of values for  $y = \frac{6}{x}$

$x$	0.5	1	1.5	2	3	4	5	6
$y$		6		3		1.5		

(b) On the grid below, draw the graph of  $y = \frac{6}{x}$  for values of  $x$  from 0.5 to 6

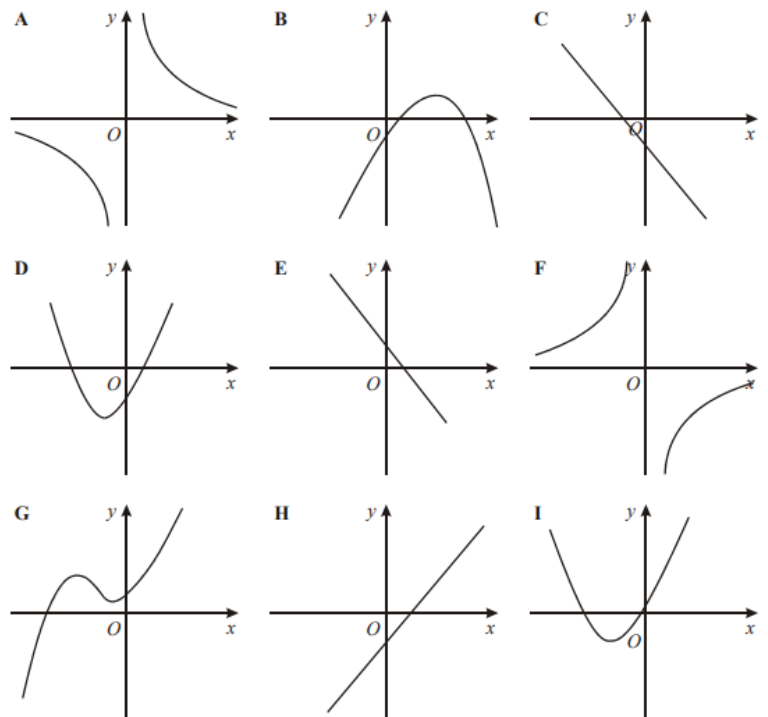


Write down the letter of the graph which could have the equation

(i)  $y = 3x - 2$

(ii)  $y = 2x^2 + 5x - 3$

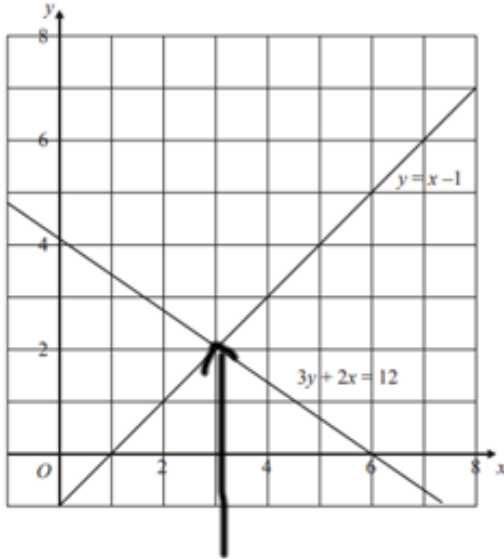
(iii)  $y = \frac{3}{x}$



# Example Questions

## Linear simultaneous equations

1) The graphs of the straight lines with equations  $3y + 2x = 12$  and  $y = x - 1$  have been drawn on the grid.



Use the graphs to solve the simultaneous equations

$$\begin{aligned}
 3y + 2x &= 12 \\
 y &= x - 1 \\
 x &= \dots\dots\dots 3 \\
 y &= \dots\dots\dots 2
 \end{aligned}$$

The coordinate where the lines intersect

2) Solve the simultaneous equations

$$\begin{aligned}
 3x + y &= -4 & \textcircled{1} \\
 3x - 4y &= 6 & \textcircled{2} \\
 \textcircled{1} - \textcircled{2} & \\
 3x - 3x &= 0 \\
 y - (-4y) &= 5y \\
 -4 - 6 &= -10 \\
 5y &= -10 & \div 5 \\
 \boxed{y = -2} & \\
 \text{Substitute into } \textcircled{1} & \\
 3x + y &= -4 \\
 3x - 2 &= -4 \\
 3x &= -2 & \div 3 \\
 x &= -\frac{2}{3} \\
 y &= -2 \\
 \boxed{x = -\frac{2}{3}} &
 \end{aligned}$$

3) Solve the simultaneous equations

$$\begin{aligned}
 x + 3y &= 12 & \textcircled{1} \\
 5x - y &= 4 & \textcircled{2} \\
 \textcircled{2} \times 3 & \\
 15x - 3y &= 12 & \textcircled{3} \\
 x + 3x &= 12 & \textcircled{1} \\
 \textcircled{3} + \textcircled{1} & \\
 16x &= 24 & \div 16 \\
 \boxed{x = \frac{24}{16} = 1.5} & \\
 \text{Substitute into } \textcircled{1} & \\
 x + 3y &= 12 \\
 1.5 + 3y &= 12 \\
 -1.5 & \quad -1.5 \\
 3y &= 10.5 \\
 \boxed{y = 3.5} & \\
 x &= 1.5 \\
 y &= 3.5
 \end{aligned}$$

4) Solve the simultaneous equations

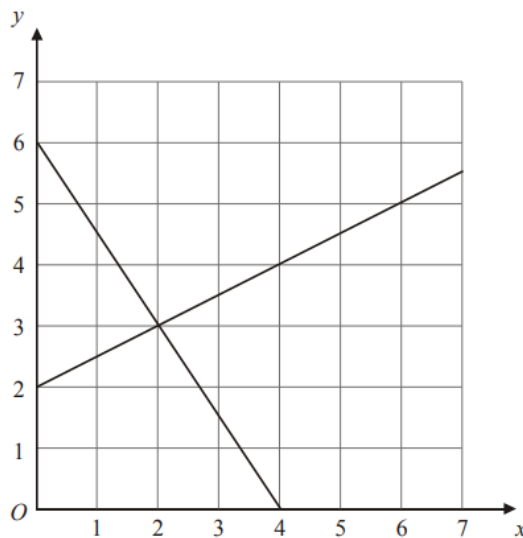
$$\begin{aligned} 3x + 2y &= 4 \quad (1) \\ 4x + 5y &= 17 \quad (2) \end{aligned}$$

$$\begin{aligned} (1) \times 4 & \quad -12x + 8y = 16 \quad (3) \\ (2) \times 3 & \quad 12x + 15y = 51 \quad (4) \\ (4) - (3) & \quad 7y = 35 \\ & \quad y = 5 \end{aligned}$$

*substitute into (1)*

$$y = 5$$

$$\begin{aligned} 3x + 2y &= 4 \\ 3x + 10 &= 4 \\ 3x &= -6 \\ \div 3 & \quad \boxed{x = -2} \\ x &= \dots -2 \dots \\ y &= \dots 5 \dots \end{aligned}$$



The diagram shows graphs of  $y = \frac{1}{2}x + 2$   
and  $2y + 3x = 12$

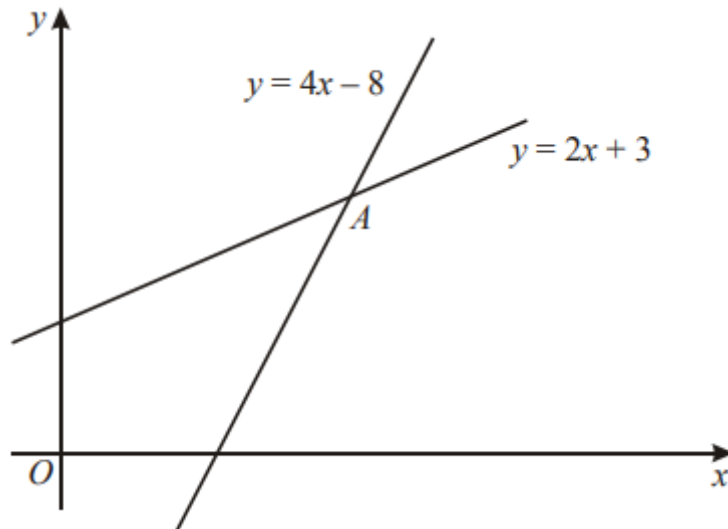
(a) Use the diagram to solve the simultaneous equations

$$y = \frac{1}{2}x + 2$$

$$2y + 3x = 12$$

$x = \dots\dots\dots$

$y = \dots\dots\dots$



The diagram shows two straight lines intersecting at point A.

The equations of the lines are

$$y = 4x - 8$$

$$y = 2x + 3$$

Work out the coordinates of A.

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

Solve

Q1)  $5x + 2y = 24$

$$3x + 2y = 16$$

$x = \dots\dots\dots$

$y = \dots\dots\dots$

Q2)  $6x - 2y = 2$

$$6x - y = 7$$

$x = \dots\dots\dots$

$y = \dots\dots\dots$

$$\begin{aligned} \text{Q3) } 9x - 2y &= 6 \\ 5x - 2y &= -2 \end{aligned}$$

$x = \dots\dots\dots$

$y = \dots\dots\dots$

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$$\begin{aligned} \text{Q4) } 4x - 3y &= 1 \\ 5x + 3y &= 35 \end{aligned}$$

$x = \dots\dots\dots$

$y = \dots\dots\dots$

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$$\begin{aligned} \text{Q5) } 2x + 2y &= 20 \\ 2x - 3y &= -10 \end{aligned}$$

$x = \dots\dots\dots$

$y = \dots\dots\dots$

$$\begin{aligned} \text{Q6) } 8x - 5y &= 7 \\ 8x - 4y &= 12 \end{aligned}$$

$x = \dots\dots\dots$

$y = \dots\dots\dots$

$$\begin{aligned} \text{Q7) } 3x - 2y &= 16 \\ x - 2y &= 4 \end{aligned}$$

$x = \dots\dots\dots$

$y = \dots\dots\dots$

$$\begin{aligned} \text{Q8) } 4x - 2y &= 6 \\ 4x - y &= 5 \end{aligned}$$

$x = \dots\dots\dots$

$y = \dots\dots\dots$

$$\begin{aligned} \text{Q9) } 4x + y &= 17 \\ 3x + 2y &= 19 \end{aligned}$$

$$x = \dots\dots\dots$$

$$y = \dots\dots\dots$$

$$\begin{aligned} \text{10) } 2x + y &= 17 \\ 3x + 2y &= 27 \end{aligned}$$

$$x = \dots\dots\dots$$

$$y = \dots\dots\dots$$

$$\begin{aligned} \text{11) } 5x + y &= 22 \\ 3x + 3y &= 18 \end{aligned}$$

$$x = \dots\dots\dots$$

$$y = \dots\dots\dots$$

$$\begin{aligned} 12) \quad & 5x + 2y = 11 \\ & 4x - 3y = 18 \end{aligned}$$

$x = \dots\dots\dots$

$y = \dots\dots\dots$

$$\begin{aligned} 13) \quad & 6x - 2y = 33 \\ & 4x + 3y = 9 \end{aligned}$$

$x = \dots\dots\dots$

$y = \dots\dots\dots$

14) A cinema sells adult tickets and child tickets.  
The total cost of 3 adult tickets and 1 child ticket is £30  
The total cost of 1 adult ticket and 3 child tickets is £22  
Work out the cost of an adult ticket and the cost of a child ticket.

adult ticket £.....

child ticket £.....