Chapter: 9

Simultaneous equations
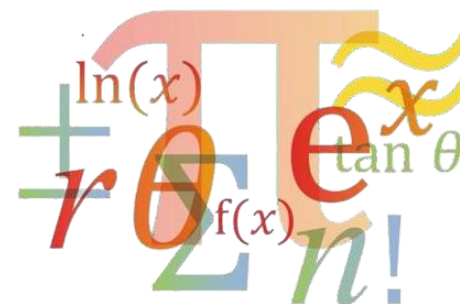
Starter Activity

1. Simplify

$$\frac{13}{39}$$

2. Find the median

4, 8, 10, 12

3. Expand

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

4. Increase 500 by 15%

5. Rearrange the letters to find the maths terms

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attics sits

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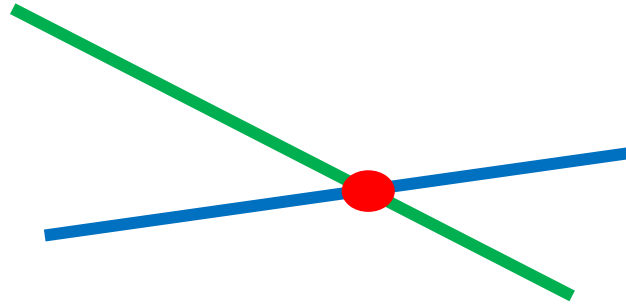
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Formula

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Transformation

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Statistics

How to Solve Simultaneous Equations

Graphs

Substitution

Elimination

Substitution

Substitution Example 1

$$y = x + 2 \quad (1)$$

$$2x + 3y = 26 \quad (2)$$

$$2x + 3(x + 2) = 26$$

$$2x + 3x + 6 = 26$$

$$5x + 6 = 26$$

$$5x = 26 - 6 = 20$$

$$x = 4$$

$$y = x + 2 \text{ so } y = 4 + 2 = 6$$

$$x = 4 \text{ and } y = 6 \quad (4,6)$$

Use Substitution to solve these simultaneous linear Equations
None of the Equations Need to be Rearranged

A

$$y = x + 1$$
$$2x + 2y = 26$$

C

$$y = 2x - 1$$
$$8x + 3y = 11$$

B

$$x = y - 3$$
$$2x + 3y = 24$$

D

$$x = 8 - 5y$$
$$3x + 2y = 11$$

Use Substitution to solve these simultaneous linear Equations
None of the Equations Need to be Rearranged

A
$$y = x + 1$$
$$2x + 2y = 26$$
$$(6,7)$$

C
$$y = 2x - 1$$
$$8x + 3y = 11$$
$$(1,1)$$

B
$$x = y - 3$$
$$2x + 3y = 24$$
$$(3,6)$$

D
$$x = 8 - 5y$$
$$3x + 2y = 11$$
$$(3,1)$$

Elimination

MAIN: TO BE ABLE TO SOLVE SIMULTANEOUS EQUATIONS
USING ADDITION AND SUBTRACTION

Elimination Example 1

$$2x + 7y = 29 \quad (1)$$

$$2x + 5y = 23 \quad (2)$$

1 - Number Each Equation

2 – Subtract (2) from (1)

$$2y = 6$$

3. Divide by 2

$$y = 3$$

4. Substitute y = 3 into (1)

$$2x + 21 = 29 \qquad x = 4 \qquad (4,3)$$

Use Substitution to solve these simultaneous linear Equations
You will have to rearrange one equation

A
$$2x - y = 4$$
$$3x + y = 11$$

C
$$x - 3y = 6$$
$$x + 3y = 0$$

B
$$2x - y = 5$$
$$x + y = 4$$

D
$$x + 2y = 3$$
$$2x + y = 0$$

Use Substitution to solve these simultaneous linear Equations

You will have to rearrange one equation

A

$2x - y = 4$

$3x + y = 11$

$(3, 2)$

C

$x - 3y = 6$

$x + 3y = 0$

$(3, -1)$

B

$2x - y = 5$

$x + y = 4$

$(3, 1)$

D

$x + 2y = 3$

$2x + y = 0$

$(-1, 2)$

Elimination Example 2

Solve the simultaneous equations

$$6x - 2y = 1 \quad \textbf{1} \quad \text{x 3}$$

$$4x - 3y = 9 \quad \textbf{2} \quad \text{x 2}$$

Multiply equation 1 by 3
Multiply equation 2 by 2

$$18x - 6y = 3 \quad \textbf{3}$$

$$-$$

$$8x - 6y = 18 \quad \textbf{4}$$

Then subtract equation 4
from equation 3

$$10x = -15$$

$$\textbf{x} = \textbf{-1.5}$$

If x = – 1.5 , then using equation 2 :

$$4(-1.5) - 3y = 9$$

$$-6 - 3y = 9$$

$$-3y = 15$$

$$\textbf{y} = \textbf{-5}$$

x = – 1.5   y = – 5

(– 1.5, – 5)

Elimination Example 3

Solve the simultaneous equations

$$4y + 3x = 4 \quad \boxed{1} \; x\,5$$

$$6y - 5x = 25 \quad \boxed{2} \; x\,3$$

$$+ \quad \begin{array}{l} 20y + 15x = 20 \quad \boxed{3} \\ 18y - 15x = 75 \quad \boxed{4} \end{array}$$

$$38y = 95$$

$$y = 2.5$$

If y = 2.5, then using equation 1 :

$$4(2.5) + 3x = 4$$

$$10 + 3x = 4$$

$$3x = -6$$

$$x = -2$$

x = – 2   y = 2.5

(– 2, 2.5)

Elimination Example 4

Four chairs and two tables cost £218.
Six chairs and seven tables cost £587.
Find the **total cost of buying twenty chairs and five tables.**

$4c + 2t = 218$　**1**　x 7

$6c + 7t = 587$　**2**　x 2

$28c + 14t = 1526$　**3**

$-$

$12c + 14t = 1174$　**4**

$16c = 352$

$c = 22$

If c = 22, then using equation 1 :

$4(22) + 2t = 218$

$88 + 2t = 218$

$2t = 130$

$t = 65$

Tables cost £65 and chairs cost £22.
What is the answer to the question?

20 (22) + 5(65) = 765

£765.00

Elimination Example 5

Five adult tickets and three child tickets for a movie cost £58.
Two adult tickets and eight child tickets for a movie cost £47.
Find the cost of each type of ticket.

$5a + 3c = 58$ ① x 8

$2a + 8c = 47$ ② x 3

$40a + 24c = 464$ ③

− $6a + 24c = 141$ ④

$34a \quad = \quad 323$

$a \quad = \quad 9.5$

If a = 9.5, then using equation 1 :

$5(9.5) + 3c = 58$

$47.5 + 3c = 58$

$3c = 10.5$

$c = 3.5$

Adult ticket costs £9.50

Child ticket costs £3.50

Five adult tickets and three child tickets for a movie cost £58.
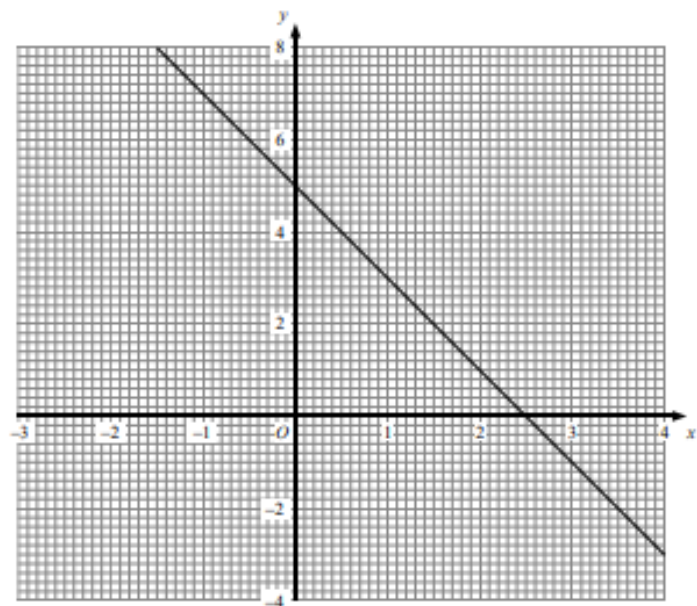Two adult tickets and eight child tickets for a movie cost £47.
Find the cost of each type of ticket.

Two numbers have a sum of 16 and a difference of 7

The area of a rectangle is 42cm^2. The perimeter of the rectangle is 26cm. What are the lengths of the sides of the rectangle?

Solving simultaneous equations graphically

The straight line $y + 2x = 5$ has been drawn on the grid.

(a) Complete this table of values for $y = 2x - 1$

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

(2)

(b) On the grid, draw the graph of $y = 2x - 1$

(2)

(c) Use your diagram to solve the simultaneous equations

$y + 2x = 5$

$y = 2x - 1$

$x = $ ....

$y = $ ....

(2)

(Total 6 marks)

Solving simultaneous equations graphically

The straight line $y + 2x = 5$ has been drawn on the grid.

(a) Complete this table of values for $y = 2x - 1$

x	−1	0	1	2	3	4
y	-3	−1	1	3	5	7

(2)

(b) On the grid, draw the graph of $y = 2x - 1$

(2)

(a) Complete this table of values for $y = 2x - 1$

x	−1	0	1	2	3	4
y		−1		3	5	

(2)

(b) On the grid, draw the graph of $y = 2x - 1$

(2)

(c) Use your diagram to solve the simultaneous equations

$y + 2x = 5$

$y = 2x - 1$

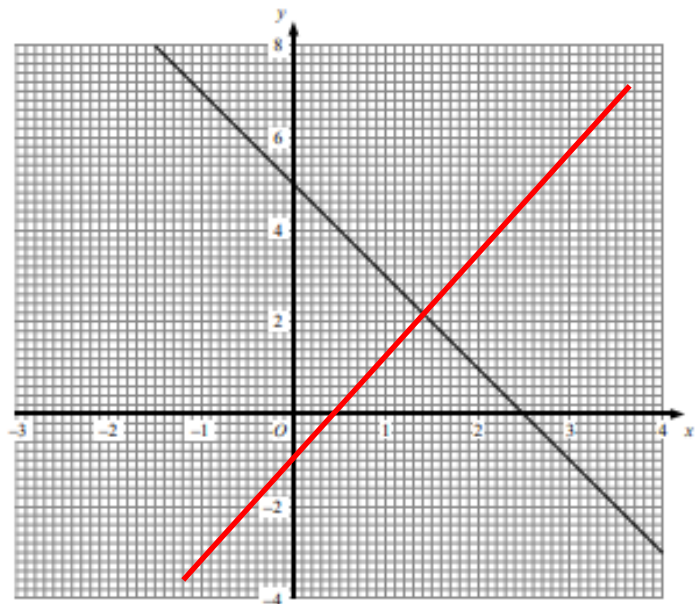$x = $ ....

$y = $ ....

(2)

(Total 6 marks)