



STEM SMART Double Maths 1 - Algebra, Indices & Straight Lines

Writing and Using Algebra 14

Essential GCSE Maths 12.14

Subject & topics: Maths | Algebra | Manipulation **Stage & difficulty:** GCSE C2, A Level P1

A postman delivers mail to four houses. House 1 receives $3s$ letters and t parcels. House 2 receives $7s$ letters. House 3 receives $5s$ letters and $2t$ parcels. House 4 receives t parcels.

Part A**Write the information as an equation**

Write an equation for the total number of items the four houses receive, N . Simplify your answer as far as possible.

The following symbols may be useful: N , s , t

Part B**Write an equation for C**

Assuming that the cost to send a letter is 80 pence and the cost to send a parcel is £5.50, write an equation for C , the total cost in pounds to send all the items that were delivered.

The following symbols may be useful: c , s , t



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Common Factors 8

Essential GCSE Maths 15.8**Subject & topics:** Maths | Algebra | Manipulation **Stage & difficulty:** GCSE P2, A Level P1

Simplify the following, factorising if possible.

Part A

$$3x^2 \times 2a \times ax^3$$

$$3x^2 \times 2a \times ax^3$$

The following symbols may be useful: a, x

Part B

$$7p \times \frac{1}{2}x^2 \div \frac{p}{4} - 7x$$

$$7p \times \frac{1}{2}x^2 \div \frac{p}{4} - 7x$$

The following symbols may be useful: p, x

Part C

$$3c \times \left(\frac{1}{2}x\right)^2 \times 8c^2x + 4c^3$$

$$3c \times \frac{1}{2}x^2 \times 8c^2x + 4c^3$$

The following symbols may be useful: c, x

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Simplifying Indices

Pre-Uni Maths for Sciences A2.6**Subject & topics:** Maths | Algebra | Manipulation**Stage & difficulty:** GCSE C3, A Level P1**Part A**

Simplify $(4a^2b^3)^{\frac{1}{2}} \times (9ab^2)^{-\frac{3}{2}}$

Simplify $(4a^2b^3)^{\frac{1}{2}} \times (9ab^2)^{-\frac{3}{2}}$

The following symbols may be useful: a, b

Part B

Simplify $(8p^3q^2)^{\frac{2}{3}} \div \left(\frac{2p}{q^{\frac{1}{3}}}\right)^5$

Simplify $(8p^3q^2)^{\frac{2}{3}} \div \left(\frac{2p}{q^{\frac{1}{3}}}\right)^5$

The following symbols may be useful: p, q

Part C

Simplify $(10^{-34})^{\frac{1}{2}}(10^{-10})^{\frac{1}{2}}(10^8)^{-\frac{5}{2}}$

Simplify $(10^{-34})^{\frac{1}{2}}(10^{-10})^{\frac{1}{2}}(10^8)^{-\frac{5}{2}}$

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Simplifying Surds

Pre-Uni Maths for Sciences A2.3**Subject & topics:** Maths | Algebra | Manipulation **Stage & difficulty:** GCSE P3, A Level P1

Simplify the following expressions.

Part A

$$2\sqrt{20} + \sqrt{45} - 5\sqrt{5}$$

Simplify $2\sqrt{20} + \sqrt{45} - 5\sqrt{5}$

Part B

$$4(\sqrt{3} + 1)(\sqrt{3} - 1) - 2(2 + \sqrt{2})(1 + \sqrt{2})$$

Simplify $4(\sqrt{3} + 1)(\sqrt{3} - 1) - 2(2 + \sqrt{2})(1 + \sqrt{2})$

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Rationalisation

Pre-Uni Maths for Sciences A2.2

Subject & topics: Maths | Algebra | Manipulation **Stage & difficulty:** GCSE P3, A Level P1

Rationalise the denominators of the following expressions.

Part A

$$\frac{3\sqrt{6}}{2\sqrt{18}}$$

Rationalise the denominator of $\frac{3\sqrt{6}}{2\sqrt{18}}$.

Part B

$$\frac{4-\sqrt{3}}{4+2\sqrt{3}}$$

Rationalise the denominator of $\frac{4 - \sqrt{3}}{4 + 2\sqrt{3}}$.

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Manipulating Algebraic Fractions 1

Pre-Uni Maths for Science A3.1

Subject & topics: Maths | Algebra | Manipulation **Stage & difficulty:** GCSE P3, A Level P2

Rearrange each of the following equations to make the indicated symbol the subject.

Part A

Find b if $\frac{1}{4a} - \frac{c}{3b} = 1$

Make b the subject of the equation $\frac{1}{4a} - \frac{c}{3b} = 1$.

The following symbols may be useful: a , b , c

Part B

Find q if $p = \frac{2}{q^2} + \frac{3}{r}$

Consider the equation $p = \frac{2}{q^2} + \frac{3}{r}$. Show that if you make q the subject of this equation it can be written in the form $q = \pm S$ and find an expression for S .

The following symbols may be useful: s , p , r

Part C**Find x if $\frac{1}{x^2} - \frac{a}{z^2} = b$**

Consider the equation $\frac{1}{x^2} - \frac{a}{z^2} = b$. Show that if you make x the subject of this equation it can be written in the form $x = \pm Y$ and find an expression for Y .

The following symbols may be useful: Y , a , b , z

Part D**Find m if $\frac{m}{a} + \frac{n}{b} = c$**

Make m the subject of the equation $\frac{m}{a} + \frac{n}{b} = c$.

The following symbols may be useful: a , b , c , m , n

Part E**Find s if $\frac{2}{r} - \frac{5}{s} = 6$**

Make s the subject of the equation $\frac{2}{r} - \frac{5}{s} = 6$.

The following symbols may be useful: r , s

Part F**Find r if $\frac{1}{p} = \frac{1}{q} + \frac{1}{r}$**

Make r the subject of $\frac{1}{p} = \frac{1}{q} + \frac{1}{r}$.

The following symbols may be useful: p , q , r

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Straight Lines: Coordinates and Lengths 2i

Subject & topics: Maths **Stage & difficulty:** A Level P1

The points A, B, and C have coordinates $(5, 1)$, $(p, 7)$, and $(8, 2)$ respectively.

Part A

Possible values of p

Given that the distance between the points A and B is twice the distance between points A and C, calculate the possible values of p .

Hence, state the possible coordinates of B.

(,)

Part B

Midpoint of AB

Given also that the line passing through A and B has equation $y = 3x - 14$, find the coordinates of the midpoint of AB.

Enter the x and y coordinates below. If a value is not a whole number, enter the value as a decimal.

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Straight Lines: Coordinates and Lengths 1ii

Subject & topics: Maths **Stage & difficulty:** A Level P2

Part A

Find coordinate

The line segment joining the points $(-2, 7)$ and $(-4, p)$ has gradient 4. Find the value of p .

The following symbols may be useful: p

Part B

Find coordinates and midpoint

The line segment joining the points $(-2, 7)$ and $(6, q)$ has midpoint $(m, 5)$. Find m and q .

Enter the values of m and q . If a value is not a whole number, enter the value as a decimal.

$m =$

$q =$

Part C**Find coordinate from length**

The line segment joining the points $(-2, 7)$ and $(d, 3)$ has length $2\sqrt{13}$. Find the two possible values of d . Enter the greatest possible value of d .

The following symbols may be useful: d

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STEM SMART Double Maths 1 - Algebra, Indices & Straight Lines

Straight lines: gradients and normals 2i

Subject & topics: Maths **Stage & difficulty:** A Level P1

A is the point $(2, 7)$ and B is the point $(-1, -2)$.

Part A

Equation of line

Find the equation of the line through A parallel to the line $y = 4x - 5$, giving your answer in the form $y = mx + c$.

The following symbols may be useful: x , y

Part B

Length of AB

Calculate the length of AB, giving your answer in simplified surd form.

Part C

Find equation of line

Find the equation of the line which passes through the midpoint of AB, and which is perpendicular to AB. Give your answer in the form $ax + by + c = 0$, where a , b , and c are integers.

The following symbols may be useful: x , y

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Lorentz Transform 1

Pre-Uni Maths for Sciences B4.7**Subject & topics:** Maths | Algebra | Manipulation **Stage & difficulty:** A Level C1

Consider the following equations

$$w_x = \frac{c \cos \theta - v}{1 - \frac{v \cos \theta}{c}}$$

$$w_y = \frac{c \sin \theta}{\gamma \left(1 - \frac{v \cos \theta}{c}\right)}$$

where $\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$.

Find an expression for $w = \sqrt{w_x^2 + w_y^2}$ in terms of one of either v, c or θ .

The following symbols may be useful: $c, \cos(), \sin(), \tan(), \text{theta}, v, w$

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