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STEM SMART Single Maths 1 - Algebra and Indices

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 $80\,\text{pence}$ 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`

STEM SMART Single Maths 1 - Algebra and Indices

Writing and Using Algebra 16

Essential GCSE Maths 12.16

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

Write the following statements in algebra.

Part A

α is twice β

α is twice β.

The following symbols may be useful: `alpha, beta`

Part B

α cubed is the same as γ squared

α cubed is the same as γ squared.

The following symbols may be useful: `alpha, gamma`

Part C

Using your equations

$\beta = 2$ and γ is a positive integer.

Find the value of γ.

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Expanding 12

Essential GCSE Maths 14.12

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

This question makes use of the Isaac equation editor, you can find instruction on how to use the equation editor here.

Expand and simplify the following.

Part A

$(x+1)(x+2)(x+3)$

$$(x+1)(x+2)(x+3)$$

The following symbols may be useful: x

Part B

$(x-5)(2x-a+4)$

$$(x-5)(2x-a+4)$$

The following symbols may be useful: a, x

Part C

$(x-3)(x-7)^2$

$$(x-3)(x-7)^2$$

The following symbols may be useful: x

Part D

$\left(\frac{1}{x}+5\right)\left(3x^2-9\right)$

$$(\frac{1}{x}+5)\,(3x^2-9)$$

The following symbols may be useful: x

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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

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

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

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 $\dfrac{1}{p} = \dfrac{1}{q} + \dfrac{1}{r}$.

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

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Manipulation of Algebraic Fractions 2

Pre-Uni Maths for Science A3.2

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

Write each of the following as a single fraction in its simplest form.

Part A

$\frac{2}{a} - \frac{3}{a+1}$

Write $\frac{2}{a} - \frac{3}{a+1}$ as a single fraction in its simplest form.

The following symbols may be useful: a

Part B

$\frac{3}{2r} - \frac{4}{3r-1}$

Write $\frac{3}{2r} - \frac{4}{3r-1}$ as a single fraction in its simplest form.

The following symbols may be useful: r

Part C

$\frac{1}{b+4} + \frac{2}{2b+3}$

Write $\dfrac{1}{b+4} + \dfrac{2}{2b+3}$ as a single fraction in its simplest form.

The following symbols may be useful: `b`

Part D

$-\frac{2}{s-2} + \frac{5}{s+3}$

Write $-\dfrac{2}{s-2} + \dfrac{5}{s+3}$ as a single fraction in its simplest form.

The following symbols may be useful: `s`

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

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(), theta, v, w`

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