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# Essential GCSE Maths 12.14



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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# Essential GCSE Maths 15.8



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

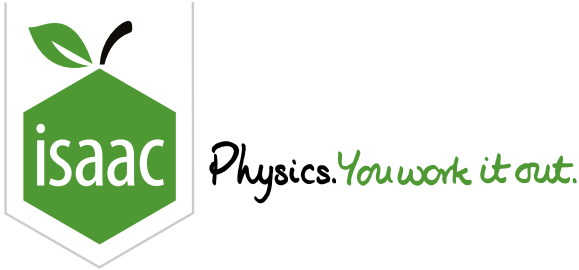
$$3c \times \left(\frac{1}{2}x\right)^2 \times 8c^2x + 4c^3$$

The following symbols may be useful:  $c$ ,  $x$

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# Simplifying Indices

GCSE

A Level

**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, p, q

**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: a, b, p, q

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

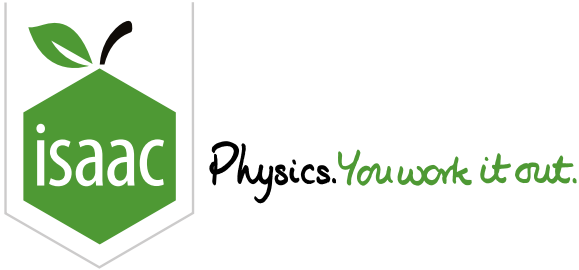
Simplify  $(10^{-34})^{\frac{1}{2}}(10^{-10})^{\frac{1}{2}}(10^8)^{-\frac{5}{2}}$

The following symbols may be useful: a, b, p, q

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# Simplifying Surds

GCSE

A Level

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

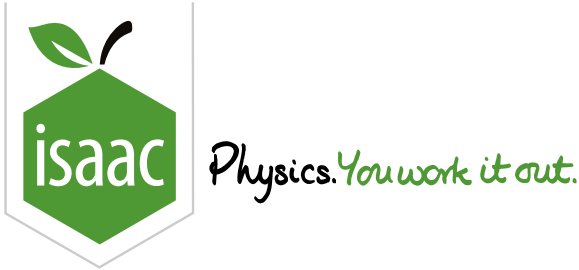
Simplify  $4(\sqrt{3} + 1)(\sqrt{3} - 1) - 2(2 + \sqrt{2})(1 + \sqrt{2})$

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# Rationalisation

GCSE

A Level

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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# Algebraic Manipulation 4.1



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:  $a$ ,  $b$ ,  $c$ ,  $m$ ,  $n$

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**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:  $r$ ,  $s$

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**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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# Matrices: nxm Rules 2i

Further A



The matrices **A**, **B** and **C** are given by  $\mathbf{A} = \begin{pmatrix} 1 & -4 \end{pmatrix}$ ,  $\mathbf{B} = \begin{pmatrix} 5 \\ 3 \end{pmatrix}$  and  $\mathbf{C} = \begin{pmatrix} 3 & 0 \\ -2 & 2 \end{pmatrix}$

## Part A **AB**

The matrix **AB** can be written as the  $1 \times 1$  matrix  $a$ .

Find  $a$ .

The following symbols may be useful: a

## Part B **BA – 4C**

Give the first row of the matrix given by **BA – 4C** in the form  $x \ y$  with a single space between  $x$  and  $y$ .

Give the second row of the matrix given by **BA – 4C** in the form  $x \ y$  with no spaces at the beginning or end.

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## 2x2 Determinants and Inverses 1ii

Further A



The matrices  $\mathbf{A}$  and  $\mathbf{B}$  are given by  $\mathbf{A} = \begin{pmatrix} 2 & 1 \\ -4 & 5 \end{pmatrix}$  and  $\mathbf{B} = \begin{pmatrix} 3 & 1 \\ 2 & 3 \end{pmatrix}$ .  $\mathbf{I}$  denotes the  $2 \times 2$  identity matrix.

### Part A $4\mathbf{A} - \mathbf{B} + 2\mathbf{I}$

Give the first row of the matrix given by  $4\mathbf{A} - \mathbf{B} + 2\mathbf{I}$  in the form  $x \ y$  with a single space between  $x$  and  $y$ .

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Give the second row of the matrix given by  $4\mathbf{A} - \mathbf{B} + 2\mathbf{I}$  in the form  $x \ y$  with a single space between  $x$  and  $y$ .

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### Part B $\mathbf{A}^{-1}$

$\mathbf{A}^{-1}$  can be written in the form  $\mathbf{A}^{-1} = \begin{pmatrix} \alpha & \beta \\ \gamma & \delta \end{pmatrix}$ .

Find  $\alpha + \beta + \gamma + \delta$  in exact form.

---

**Part C**  $(\mathbf{AB}^{-1})^{-1}$ 

$(\mathbf{AB}^{-1})^{-1}$  can be written in the form  $(\mathbf{AB}^{-1})^{-1} = \begin{pmatrix} \alpha & \beta \\ \gamma & \delta \end{pmatrix}$ .

Find  $\alpha + \beta + \gamma + \delta$  in exact form.

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# Matrices: 3x3 Determinants and Inverses 1i

Further A



The matrix **A** is given by  $\mathbf{A} = \begin{pmatrix} a & 8 & 10 \\ 2 & 1 & 2 \\ 4 & 3 & 6 \end{pmatrix}$ . The matrix **B** is such that  $\mathbf{AB} = \begin{pmatrix} a & 6 & 1 \\ 1 & 1 & 0 \\ 1 & 3 & 0 \end{pmatrix}$ .

## Part A $\det \mathbf{AB}$

Find  $\det \mathbf{AB}$ .

The following symbols may be useful: a

## Part B $(\mathbf{AB})^{-1}$

Give the first row of  $(\mathbf{AB})^{-1}$  in the form  $x \ y \ z$  with a space between  $x$ ,  $y$  and  $z$ .  $x$ ,  $y$  and  $z$  are in exact form.

Give the second row of  $(\mathbf{AB})^{-1}$  in the form  $x \ y \ z$  with a space between  $x$ ,  $y$  and  $z$ .  $x$ ,  $y$  and  $z$  are in exact form.

Give the third row of  $(\mathbf{AB})^{-1}$  in the form  $x \ y \ z$  with a space between  $x$ ,  $y$  and  $z$ .  $x$ ,  $y$  and  $z$  are in exact form.

**Part C**    $\mathbf{B}^{-1}$ 

Give the first row of  $\mathbf{B}^{-1}$  in the form  $x \ y \ z$  with a space between  $x$ ,  $y$  and  $z$ .  $x$ ,  $y$  and  $z$  are in exact form.

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Give the second row of  $\mathbf{B}^{-1}$  in the form  $x \ y \ z$  with a space between  $x$ ,  $y$  and  $z$ .  $x$ ,  $y$  and  $z$  are in exact form.

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Give the third row of  $\mathbf{B}^{-1}$  in the form  $x \ y \ z$  with a space between  $x$ ,  $y$  and  $z$ .  $x$ ,  $y$  and  $z$  are in exact form.

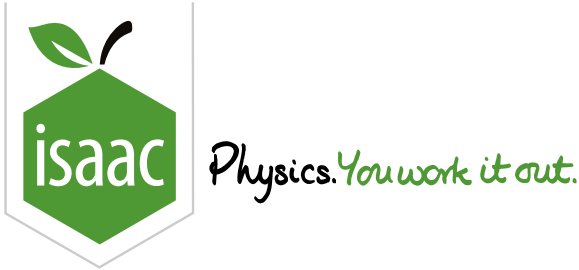
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# Algebraic Manipulation 5.4

GCSE   A Level

c

c

c

c

c

c

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  $\theta$ .

The following symbols may be useful: `c`, `cos()`, `sin()`, `tan()`, `theta`, `v`, `w`

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