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Maths

**Exponentials and Logs** 

# **Exponentials and Logs**



### Part A Sketching

Consider the curve  $y=6\times 5^x$ , sketch it and find the value of the y intercept of the curve.

What is the value of the y intercept of the curve?

The following symbols may be useful: y

### Part B Find x-coordinate

The point P on the curve  $y = 9^x$  has y-coordinate equal to 150. Use logarithms to find the x-coordinate of P.

Give the x-coordinate of P to 3 significant figures.

#### Part C New x-coordinate

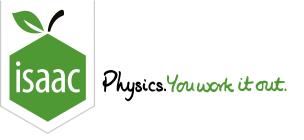
The curves  $y=6\times 5^x$  and  $y=9^x$  intersect at the point Q. Find the exact value of the x-coordinate at point Q, giving any logarithms in base three.

Give the exact value of the x-coordinate at point Q, giving any logarithms in base three  $(\log_3)$ .

When you are entering your answer, note that  $\log_a b$  can be written using  $\log(b,a)$ .

The following symbols may be useful: log(), x

Used with permission from UCLES, A Level, January 2010, Paper 4722, Question 9.



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Maths

Solving Equations & Logs 2i

# Solving Equations & Logs 2i



### Part A Solve equation

Use logarithms to solve the equation  $2^{n-3}=18000$ , giving your answer to 3 significant figures.

### Part B Simultaneous equations

Solve the simultaneous equations  $\log_2 x \,+\, \log_2 y \,=\, 8\,$  and  $\,\log_2(rac{x^2}{y}) \,=\, 7\,$ 

State the value of x.

The following symbols may be useful: x

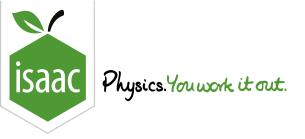
State the value of y.

The following symbols may be useful: y

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# **Logarithmic Plots 4**



A student used a graph of  $\ln y$  against x to discover that  $y=e^{2x+5}$ .

What were the gradient and intercept of the graph?

## Part A Find the gradient

What was the gradient of the graph?

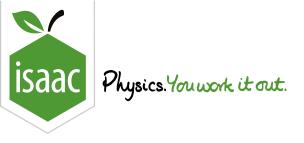
## Part B Find the intercept

What was the intercept of the graph?

Adapted for Isaac Physics from NST IA Biology preparation work

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Maths Straight lines: gradients and normals 1i

# Straight lines: gradients and normals 1i



#### Gradient of line Part A

Find the gradient of the line  $l_1$  which has equation 4x - 3y + 5 = 0.

#### Perpendicular line Part B

Find the equation of the line  $l_2$ , which passes through the point (1,2) and is perpendicular to the line  $l_1$ , giving your answer in the form ax + by + c = 0 where a, b and c are integers.

The following symbols may be useful: x, y

#### Midpoint Part C

The line  $l_1$  crosses the x-axis at P and the line  $l_2$  crosses the y-axis at Q. Find the coordinates of the midpoint of PQ.

Enter the *x*-coordinate:

The following symbols may be useful: x, y

Enter the y-coordinate:

The following symbols may be useful: x, y

#### 

Find the length of PQ.

Used with permission from UCLES, A level, June 2005, Paper 4721, Question 9

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Maths

Algebra and Roots: Cubics with Substitution 1ii

# Algebra and Roots: Cubics with Substitution 1ii



The cubic equation  $3x^3-9x^2+6x+2=0$  has roots  $\alpha$ ,  $\beta$  and  $\gamma$ .

#### Part A Roots

Give the value of  $\alpha + \beta + \gamma$ .

The following symbols may be useful: k

Give the value of  $\alpha\beta + \beta\gamma + \gamma\alpha$ .

Part B 
$$\alpha^2 + \beta^2 + \gamma^2$$

Hence, find the value of  $\alpha^2+\beta^2+\gamma^2$ .

#### **Part C** Substitution

Use the substitution  $x=\frac{1}{u}$  to find a cubic equation in u in the form  $au^3+bu^2+cu+d=0$  where a,b,c and d are integers.

The following symbols may be useful: u

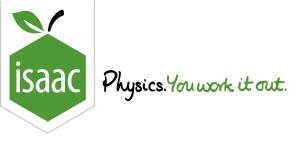
Part D 
$$\frac{1}{\alpha} + \frac{1}{\beta} + \frac{1}{\gamma}$$

Find the value of  $\frac{1}{\alpha} + \frac{1}{\beta} + \frac{1}{\gamma}$ .

Adapted with permission from UCLES, A Level, June 2007, Paper 4725, Question 6.

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Maths

**Roots of Polynomials** 

# **Roots of Polynomials**



This question is about manipulation of the roots of two polynomials.

$$x^2 + kx + 2k = 0$$

has the roots  $\alpha$  and  $\beta$ , while

$$x^3 + 4x + 3 = 0$$

has the roots lpha', eta' and  $\gamma'$ . Take k 
eq 0.

## Part A Roots of the quadratic

Find a quadratic equation with roots  $\frac{\alpha}{\beta}$  and  $\frac{\beta}{\alpha}$ .

The following symbols may be useful: k,  $\times$ 

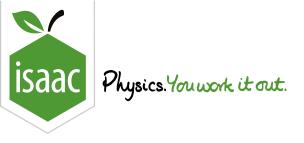
### Part B Substitution

Starting from the cubic equation above, use the substitution  $x=\sqrt{u}$  to obtain a cubic equation in u.

The following symbols may be useful: u

### Part C Roots of the cubic

Find an expression for  ${\alpha'}^4 + {\beta'}^4 + {\gamma'}^4 + {\alpha'}{\beta'}{\gamma'}$ .



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Matrices: nxm Rules 1i

# Matrices: nxm Rules 1i



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

### Part A ${f A}-4{f B}$

The result of 
$${f A}-4{f B}$$
 can be written in the form  $egin{pmatrix} x \ y \ z \end{pmatrix}$ 

Find x.

The following symbols may be useful: x

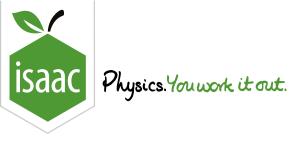
Find y.

The following symbols may be useful: y

Find z.

The following symbols may be useful:  $\boldsymbol{z}$ 

Part B BC
Give the first row of the matrix given by ${f BC}$ in the form $x\ y\ z$ with a single space between $x,y$ and $z$ .
Give the second row of the matrix given by ${f BC}$ in the form $x\ y\ z$ with a single space between $x,y$ and $z$ .
Give the final row of the matrix given by ${f BC}$ in the form $x\ y\ z$ with a single space between $x,y$ and $z$ .
Part C CA
In contrast to the previous part of the question, the matrix ${f CA}$ is a $1 imes 1$ matrix $a.$
Find $a.$
The following symbols may be useful: a
Adapted with permission from UCLES, A Level, June 2008, Paper 4725, Question 5.
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Maths

Matrices

# Matrices



This question will look at 4 matrices A, B, C and D given by

$$\mathbf{A} = egin{pmatrix} 3 & 4 \ 2 & -3 \end{pmatrix}$$

$$\mathbf{B} = egin{pmatrix} 4 & 6 \ 3 & -5 \end{pmatrix}$$

$$\mathbf{C} = egin{pmatrix} a & 3 \ -2 & 1 \end{pmatrix}$$

$$\mathbf{D}=egin{pmatrix}2&-1&1\0&3&1\1&1&b\end{pmatrix}$$

where  $b \neq 1$ .

#### Matrix equation Part A

p and q satisfy the equation  $p\mathbf{A}+q\mathbf{B}=\mathbf{I}$  where  $\mathbf{I}$  is the identity matrix.

Find the constant p.

The following symbols may be useful: p

Find the constant q.

The following symbols may be useful: q

## Part B A singularity!

Given that  ${f C}$  is singular, find the value of a.

The following symbols may be useful: a

# Part C $\mathbf{C}^{-1}$

Given that  ${f C}$  is non singular, its inverse can be written in the form  ${f C}^{-1}=egin{pmatrix} lpha & eta \\ \gamma & \delta \end{pmatrix}$  .

Give an expression for  $\alpha+\beta+\gamma+\delta$  as a single fraction.

The following symbols may be useful: a

## Part D Simultaneous equations

Using the previous part, solve the following simultaneous equations

$$ax + 3y = 1$$

$$-2x + y = -1$$

Give an expression for x as a single fraction.

The following symbols may be useful: a, x

Give an expression for y as a single fraction.

The following symbols may be useful: a, y

Find the determinant of  $\mathbf{D}$  in terms of b.

The following symbols may be useful: b

 $\mathbf{D}^{-1}$  can be written in the form

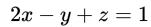
$$\begin{pmatrix} \alpha & \beta & \gamma \\ \delta & \epsilon & \zeta \\ \eta & \theta & \iota \end{pmatrix}.$$

Find  $\alpha-\beta+\gamma-\delta+\epsilon-\zeta+\eta-\theta+\iota$  as a single fraction.

The following symbols may be useful: b

## Part F More simultaneous equations

Heina i	the answer to t	ha provious	nart o	r otherwice	salve the	following	sat of	cimultaneous	aduations
USING	lile aliswel to t	ne previous	part, o	n olitetwise,	Solve the	TOHOWING	261 OI	Simulaneous	equations



$$3y+z=2$$

$$x + y + bz = 2$$

Give an expression for x in terms of b as a single fraction.

The following symbols may be useful: b, x

Give an expression for y in terms of b as a single fraction.

The following symbols may be useful: b, y

Give an expression for z in terms of b as a single fraction.

The following symbols may be useful: b, z

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