

Part A

Maths

Stationary Points 2ii

# **Stationary Points 2ii**



Find the coordinates of the stationary points on the curve $y=x^3-3x^2+4$ . Enter the $x$ and $y$
coordinates of the stationary point with the greatest $x$ coordinate.

Enter the *x*-coordinate:

Find coordinate

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

#### Enter the y-coordinate:

The following symbols may be useful: y

### Part B Stationary point

Determine whether the stationary point whose coordinates you entered is a maximum point or a minimum point.

Maximum
Minimum
Inconclusive

### ${\bf Part \ C} \qquad {\bf Range \ of} \ x$

What form doe then find $a$ and	es your answer take? Choose from the list below, where $a$ and $b$ are constants and $a < b$ , and $a < b$ .
$\bigcirc  x < a$	
$\bigcirc  x \leq a$	
$\bigcirc  x > a$	
$\bigcirc  x \geq a$	
$\bigcirc$ $a < x <$	< b
$\bigcirc  a \leq x \leq$	$\leq b$
$\bigcirc  x < a \ o$	r $x>b$
$x \leq a$ o	r $x \geq b$
Write down the	$oldsymbol{e}$ value of $a$ .
	e value of $b$ (or if your chosen form has no $b$ , write "n").
The following symbols m	ay be useful: n

For which range of values of x does  $x^3 - 3x^2 + 4$  decrease as x increases?

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Maths

Maxima and Minima: Problems 2i

### Maxima and Minima: Problems 2i



A particle P moving in a straight line has velocity v m s<sup>-1</sup> at time t s after passing through a fixed point O. It is given that  $v=3.2-0.2t^2$  for  $0 \le t \le 5$ . Calculate

#### Part A t at rest

the time (t seconds) at which P is at instantaneous rest.

#### Part B Acceleration

the acceleration of *P* when it is at instantaneous rest.

#### Part C Greatest distance

the greatest distance of P from O (to 3 significant figures).

Used with permission from UCLES, A Level, June 2015, Paper 4721, Question 9.



Maths

Maxima and Minima: Problems 2ii

### Maxima and Minima: Problems 2ii



A curve has equation  $y = 3x^3 - 7x + \frac{2}{x}$ 

### Part A Verify stationary point

Verify the curve has a stationary point when x = 1.

More practice questions?

#### Part B Nature of stationary point

Determine the nature of this stationary point.

Neither/inconclusive

Minimum

Maximum

#### Part C Tangent to curve

The tangent to the curve at this stationary point meets the y-axis at the point Q. Find the y-coordinate of Q.

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<u>Home</u> Maths Calculus Differentiation Minimising the area

## Minimising the area



A rectangular cuboid has a base with sides of length a and b and a height c. Its volume V and height c are fixed. By following the steps below find expressions in terms of V and c for the values of a and b which will minimise the surface area a of the cuboid, find an expression for this minimum surface area and check that this is indeed a minimum.

#### Part A Volume V and surface area A

Write down the equation for the volume $V$ of the rectangular cuboid in terms of $a,b$ and $a$	Write	down	the e	guation	for the	volume	V	of the	rectangular	cuboid	in	terms	of	a.	b  an	dc
--	-------	------	-------	---------	---------	--------	---	--------	-------------	--------	----	-------	----	----	-------	----

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

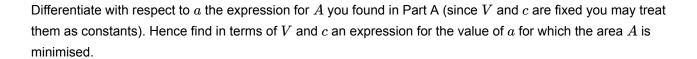
Write down the equation for the area A of the rectangular cuboid in terms of a, b and c.

The following symbols may be useful: A ,  $\,$  a ,  $\,$  b ,  $\,$  c

From your equation for V deduce an expression for b in terms of V, a and c. Hence, by substitution, obtain an equation for A in terms of V, a and c.

The following symbols may be useful: A,  $\,$  V,  $\,$ a,  $\,$ c

#### 



The following symbols may be useful: V ,  $\ \ c$ 

Find, in terms of V and c, the expression for b corresponding to this value of a.

The following symbols may be useful: V,  $\ c$ 

#### Part C The minimum area

Find an expression for the minimum area in terms of V and c.

The following symbols may be useful: V,  $\ c$ 

#### Part D Check that the area is a minimum

Find, at the value of a deduced in Part B, an expression in terms of V and c for the second derivative of A with respect to a; convince yourself that the value of the second derivative indicates that the value of A is a minimum at this point.

The following symbols may be useful: V, c

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Maths

Stationary Points 4ii

# Stationary Points 4ii



Part A Find coordinates
Find the coordinates of the stationary point on the curve $y=x^4+32x$ . Enter the $x$ and $y$ coordinates below.
Enter $x$ coordinate:
The following symbols may be useful: x
Enter $y$ coordinate:
The following symbols may be useful: y
Part B Maxima or Minima
Determine whether this stationary point is a maximum or a minimum.
Minimum
Maximum
Part C Range of $x$
For what range of values of $x$ does $x^4+32x$ increase as $x$ increases? Give your answer in the form of an inequality.
The following symbols may be useful: <, <=, >, >=, $\times$



Maths

Maxima and Minima: Problems 1i

### Maxima and Minima: Problems 1i



A cuboid has an volume of exactly  $8 \,\mathrm{m}^3$ . The base of the cuboid is a square with side length x metres. The surface area of the cuboid is  $A \,\mathrm{m}^2$ .

#### Part A Find expression for A

Show that A can be expressed in the form  $ax^2+\frac{b}{x}$ , where a and b are constants, and find this expression.

The following symbols may be useful: x

### Part B Find $\frac{\mathrm{d}A}{\mathrm{d}x}$

Find  $\frac{\mathrm{d}A}{\mathrm{d}x}$ .

The following symbols may be useful: x

#### Part C Find minimum

Find the value of x which gives the smallest surface area of the cuboid.

The following symbols may be useful: x

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Maths

Stationary Points 1ii

# **Stationary Points 1ii**



The curve  $y = x^3 - kx^2 + x - 3$  has two stationary points.

#### Part A Differentiate

Find  $\frac{\mathrm{d}y}{\mathrm{d}x}$ .

The following symbols may be useful:  $k\,\text{,}\ \ \, x$ 

#### Part B Find k

Given that there is a stationary point when x=1, find the value of k.

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

#### Part C Differentiate twice

Find  $\frac{\mathrm{d}^2 y}{\mathrm{d} x^2}$ .

The following symbols may be useful: x

Hence determine whether the stationary point is a minimum or a maximum.

Maximum

Minimum

# 

Used with permission from UCLES, A Level, June 2009, Paper 4721, Question 10.

Maths

Stationary Points 1i

# Stationary Points 1i



#### Part A Find stationary points

Find the coordinates of the stationary points on the curve $y=2x^3-3x^2-12x-7$ . Enter the $x$ and	$id\ y$
coordinates of the stationary point with the largest $x$ coordinate.	

Enter the x coordinate:

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

#### Enter the y coordinate:

The following symbols may be useful: y

#### Part B Nature of stationary points

Determine whether each stationary point is a minimum or maximum point. Identify the nature of the stationary point whose coordinates you have entered in Part A.

Maximum
Maximum

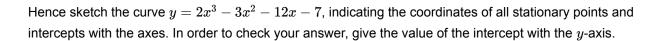
Minimum

#### Part C Expand and simplify

Expand and simplify  $(x+1)^2(2x-7)$ .

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

#### Part D Sketch



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

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Maths

Maxima and Minima: Problems 1ii

### Maxima and Minima: Problems 1ii



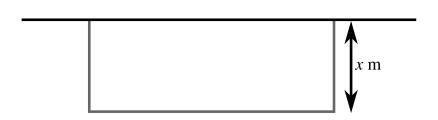


Figure 1: The diagram shows a rectangular enclosure, with a wall forming one side. A rope, of length  $20\,$  metres, is used to form the remaining three sides. The width of the enclosure is x metres, and the area of the enclosure is x metres.

#### Part A Express as equation

Show that A can be expressed in the form  $px-qx^2$ , and find this expression.

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

#### Part B Use differentiation

Use differentiation to find the maximum value of A.

The following symbols may be useful: A

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