

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	



General Certificate of Education
Advanced Subsidiary Examination
June 2010

Mathematics

MPC1

Unit Pure Core 1

Monday 24 May 2010 1.30 pm to 3.00 pm

For this paper you must have:

- the blue AQA booklet of formulae and statistical tables.
- You must **not** use a calculator.



Time allowed

- 1 hour 30 minutes

Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer the questions in the spaces provided. Do not write outside the box around each page.
- Show all necessary working; otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.
- The use of calculators is **not** permitted.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

Advice

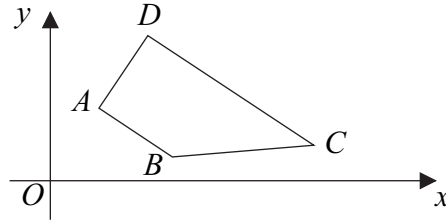
- Unless stated otherwise, you may quote formulae, without proof, from the booklet.



J U N 1 0 M P C 1 0 1

Answer **all** questions in the spaces provided.

1 The trapezium $ABCD$ is shown below.



The line AB has equation $2x + 3y = 14$ and DC is parallel to AB .

- (a) Find the gradient of AB . (2 marks)
- (b) The point D has coordinates $(3, 7)$.
 - (i) Find an equation of the line DC . (2 marks)
 - (ii) The angle BAD is a right angle. Find an equation of the line AD , giving your answer in the form $mx + ny + p = 0$, where m, n and p are integers. (4 marks)
- (c) The line BC has equation $5y - x = 6$. Find the coordinates of B . (3 marks)

QUESTION
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A series of horizontal dotted lines for writing answers, corresponding to the question parts (a), (b), (c), (i), and (ii).



3 The polynomial $p(x)$ is given by

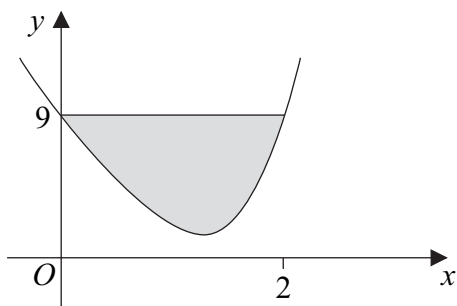
$$p(x) = x^3 + 7x^2 + 7x - 15$$

- (a) (i)** Use the Factor Theorem to show that $x + 3$ is a factor of $p(x)$. *(2 marks)*
- (ii)** Express $p(x)$ as the product of three linear factors. *(3 marks)*
- (b)** Use the Remainder Theorem to find the remainder when $p(x)$ is divided by $x - 2$. *(2 marks)*
- (c) (i)** Verify that $p(-1) < p(0)$. *(1 mark)*
- (ii)** Sketch the curve with equation $y = x^3 + 7x^2 + 7x - 15$, indicating the values where the curve crosses the coordinate axes. *(4 marks)*

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- 4 The curve with equation $y = x^4 - 8x + 9$ is sketched below.



The point $(2, 9)$ lies on the curve.

(a) (i) Find $\int_0^2 (x^4 - 8x + 9) dx$. (5 marks)

(ii) Hence find the area of the shaded region bounded by the curve and the line $y = 9$. (2 marks)

(b) The point $A(1, 2)$ lies on the curve with equation $y = x^4 - 8x + 9$.

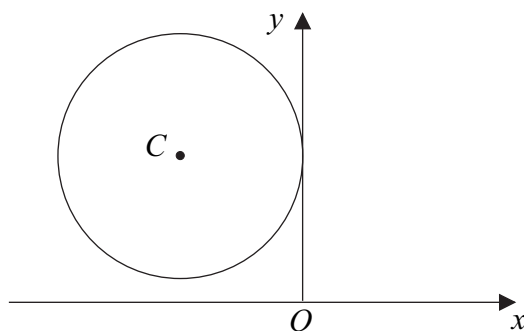
(i) Find the gradient of the curve at the point A . (4 marks)

(ii) Hence find an equation of the tangent to the curve at the point A . (1 mark)

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5 A circle with centre $C(-5, 6)$ touches the y -axis, as shown in the diagram.



(a) Find the equation of the circle in the form

$$(x - a)^2 + (y - b)^2 = r^2 \quad (3 \text{ marks})$$

(b) (i) Verify that the point $P(-2, 2)$ lies on the circle. (1 mark)

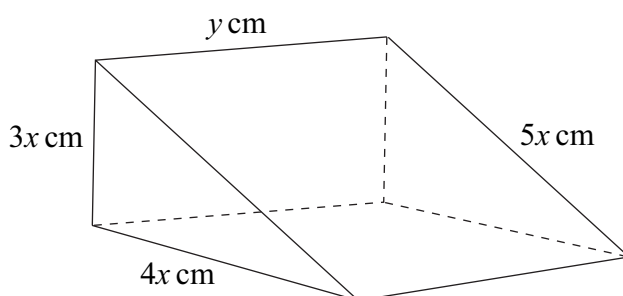
(ii) Find an equation of the normal to the circle at the point P . (3 marks)

(iii) The mid-point of PC is M . Determine whether the point P is closer to the point M or to the origin O . (4 marks)

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- 6** The diagram shows a block of wood in the shape of a prism with triangular cross-section. The end faces are right-angled triangles with sides of lengths $3x$ cm, $4x$ cm and $5x$ cm, and the length of the prism is y cm, as shown in the diagram.



The total surface area of the five faces is 144 cm^2 .

- (a) (i)** Show that $xy + x^2 = 12$. (3 marks)

- (ii)** Hence show that the volume of the block, $V \text{ cm}^3$, is given by

$$V = 72x - 6x^3 \quad (2 \text{ marks})$$

- (b) (i)** Find $\frac{dV}{dx}$. (2 marks)

- (ii)** Show that V has a stationary value when $x = 2$. (2 marks)

- (c)** Find $\frac{d^2V}{dx^2}$ and hence determine whether V has a maximum value or a minimum value when $x = 2$. (2 marks)

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- 7 (a) (i)** Express $2x^2 - 20x + 53$ in the form $2(x - p)^2 + q$, where p and q are integers. (2 marks)
- (ii)** Use your result from part **(a)(i)** to explain why the equation $2x^2 - 20x + 53 = 0$ has no real roots. (2 marks)
- (b)** The quadratic equation $(2k - 1)x^2 + (k + 1)x + k = 0$ has real roots.
- (i)** Show that $7k^2 - 6k - 1 \leq 0$. (4 marks)
- (ii)** Hence find the possible values of k . (4 marks)

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