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	
8	
TOTAL	

AQA

General Certificate of Education
Advanced Subsidiary Examination
June 2014

Mathematics MPC1

Unit Pure Core 1

Monday 19 May 2014 9.00 am to 10.30 am

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 each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do **not** use the space provided for a different question.
- 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.
- You do not necessarily need to use all the space provided.

Answer **all** questions.

Answer each question in the space provided for that question.

1 The point A has coordinates $(-1, 2)$ and the point B has coordinates $(3, -5)$.

(a) (i) Find the gradient of AB.

[2 marks]

(ii) Hence find an equation of the line AB, giving your answer in the form $px + qy = r$, where p, q and r are integers.

[3 marks]

(b) The midpoint of AB is M.

(i) Find the coordinates of M.

[1 mark]

(ii) Find an equation of the line which passes through M and which is perpendicular to AB.

[3 marks]

(c) The point C has coordinates $(k, 2k + 3)$. Given that the distance from A to C is $\sqrt{13}$, find the two possible values of the constant k.

[4 marks]

QUESTION PART REFERENCE

Answer space for question 1

2 A rectangle has length $(9 + 5\sqrt{3})\,\text{cm}$ and area $(15 + 7\sqrt{3})\,\text{cm}^2$.

Find the width of the rectangle, giving your answer in the form $(m + n\sqrt{3})\,\text{cm}$, where m and n are integers.

[4 marks]

QUESTION PART REFERENCE

Answer space for question 2

3 A curve has equation $y = 2x^5 + 5x^4 - 1$.

(a) Find:

(i) $\frac{dy}{dx}$

[2 marks]

(ii) $\frac{d^2y}{dx^2}$

[1 mark]

(b) The point on the curve where $x = -1$ is P.

(i) Determine whether y is increasing or decreasing at P, giving a reason for your answer.
[2 marks]

(ii) Find an equation of the tangent to the curve at P.

[3 marks]

(c) The point $Q(-2, 15)$ also lies on the curve. Verify that Q is a maximum point of the curve.

[4 marks]

QUESTION PART REFERENCE	**Answer space for question 3**

4 (a) (i) Express $16 - 6x - x^2$ in the form $p - (x + q)^2$ where p and q are integers.

[2 marks]

(ii) Hence write down the maximum value of $16 - 6x - x^2$.

[1 mark]

(b) (i) Factorise $16 - 6x - x^2$.

[1 mark]

(ii) Sketch the curve with equation $y = 16 - 6x - x^2$, stating the values of x where the curve crosses the x-axis and the value of the y-intercept.

[3 marks]

QUESTION PART REFERENCE

Answer space for question 4

5 The polynomial $\mathrm{p}(x)$ is given by

$$\mathrm{p}(x) = x^3 + cx^2 + dx + 3$$

where c and d are integers.

(a) Given that $x + 3$ is a factor of $\mathrm{p}(x)$, show that

$$3c - d = 8$$

[2 marks]

(b) The remainder when $\mathrm{p}(x)$ is divided by $x - 2$ is 65.

Obtain a further equation in c and d.

[2 marks]

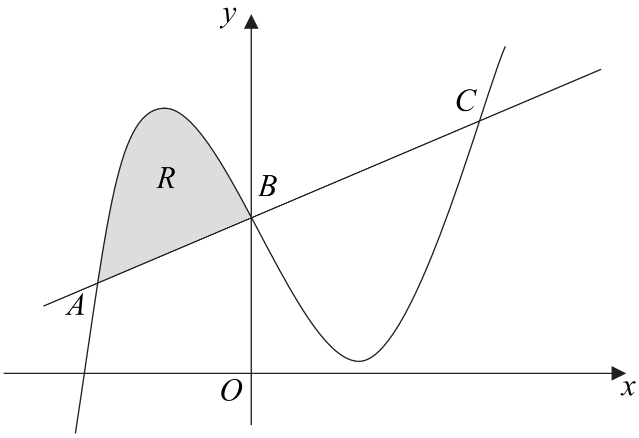
(c) Use the equations from parts **(a)** and **(b)** to find the value of c and the value of d.

[3 marks]

QUESTION PART REFERENCE

Answer space for question 5

6 The diagram shows a curve and a line which intersect at the points A, B and C.



The curve has equation $y = x^3 - x^2 - 5x + 7$ and the straight line has equation $y = x + 7$. The point B has coordinates $(0, 7)$.

(a) (i) Show that the x-coordinates of the points A and C satisfy the equation

$$x^2 - x - 6 = 0$$

[2 marks]

(ii) Find the coordinates of the points A and C.

[3 marks]

(b) Find $\int (x^3 - x^2 - 5x + 7)\,\mathrm{d}x$.

[3 marks]

(c) Find the area of the shaded region R bounded by the curve and the line segment AB.

[4 marks]

QUESTION PART REFERENCE	Answer space for question 6

7 A circle with centre C has equation $x^2 + y^2 - 10x + 12y + 41 = 0$. The point $A(3, -2)$ lies on the circle.

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

$$(x-a)^2 + (y-b)^2 = k$$

[3 marks]

(b) (i) Write down the coordinates of C.

[1 mark]

(ii) Show that the circle has radius $n\sqrt{5}$, where n is an integer.

[2 marks]

(c) Find the equation of the tangent to the circle at the point A, giving your answer in the form $x + py = q$, where p and q are integers.

[5 marks]

(d) The point B lies on the tangent to the circle at A and the length of BC is 6. Find the length of AB.

[3 marks]

QUESTION PART REFERENCE

Answer space for question 7

Do not write outside the box

8 Solve the following inequalities:

(a) $3(1-2x)-5(3x+2)>0$

[2 marks]

(b) $6x^2 \leqslant x+12$

[4 marks]

QUESTION PART REFERENCE

Answer space for question 8