Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME		
CENTRE NUMBER		CANDIDATE NUMBER

ADDITIONAL MATHEMATICS **4037/22**

Paper 2 **October/November 2014**

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

This document consists of **15** printed pages and **1** blank page.

DC (SJF/SLM) 97558

Mathematical Formulae

1. ALGEBRA

Quadratic Equation

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Binomial Theorem

$$(a + b)^n = a^n + \binom{n}{1} a^{n-1} b + \binom{n}{2} a^{n-2} b^2 + \ldots + \binom{n}{r} a^{n-r} b^r + \ldots + b^n,$$

where n is a positive integer and $\binom{n}{r} = \dfrac{n!}{(n-r)!r!}$

2. TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$

$$\sec^2 A = 1 + \tan^2 A$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

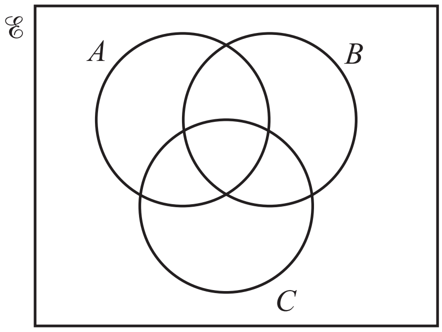
Formulae for ΔABC

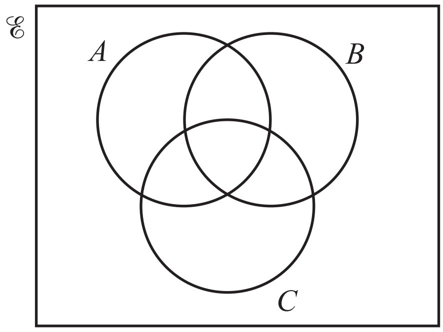
$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\Delta = \frac{1}{2} bc \sin A$$

1 **(a)** On each of the Venn diagrams below shade the region which represents the given set.





$(A \cap B) \cup C'$ $\qquad\qquad$ $A' \cap (B \cup C)$ [2]

(b) In a year group of 98 pupils, F is the set of pupils who play football and H is the set of pupils who play hockey. There are 60 pupils who play football and 50 pupils who play hockey. The number that play both sports is x and the number that play neither is $30 - 2x$. Find the value of x. [3]

2 Solve the inequality $9x^2 + 2x - 1 < (x + 1)^2$. [3]

3 Solve the following simultaneous equations.

$$\log_2(x + 3) = 2 + \log_2 y$$

$$\log_2(x + y) = 3$$ [5]

4 The functions f and g are defined for real values of x by

$$f(x) = \sqrt{x-1} - 3 \qquad \text{for } x > 1,$$

$$g(x) = \frac{x-2}{2x-3} \qquad \text{for } x > 2.$$

(i) Find gf(37). [2]

(ii) Find an expression for $f^{-1}(x)$. [2]

(iii) Find an expression for $g^{-1}(x)$. [2]

5 The number of bacteria B in a culture, t days after the first observation, is given by

$$B = 500 + 400e^{0.2t}.$$

(i) Find the initial number present. [1]

(ii) Find the number present after 10 days. [1]

(iii) Find the rate at which the bacteria are increasing after 10 days. [2]

(iv) Find the value of t when $B = 10\,000$. [3]

6 **(i)** Calculate the coordinates of the points where the line $y = x + 2$ cuts the curve $x^2 + y^2 = 10$. [4]

(ii) Find the exact values of m for which the line $y = mx + 5$ is a tangent to the curve $x^2 + y^2 = 10$. [4]

7 A particle moving in a straight line passes through a fixed point O. The displacement, x metres, of the particle, t seconds after it passes through O, is given by $x = t + 2\sin t$.

(i) Find an expression for the velocity, $v\,\mathrm{m\,s^{-1}}$, at time t. [2]

When the particle is first at instantaneous rest, find

(ii) the value of t, [2]

(iii) its displacement and acceleration. [3]

8 **(i)** Given that $y = \dfrac{x^2}{2 + x^2}$, show that $\dfrac{dy}{dx} = \dfrac{kx}{(2 + x^2)^2}$, where k is a constant to be found. [3]

(ii) Hence find $\displaystyle\int \frac{x}{(2 + x^2)^2}\, dx$. [2]

9 Integers a and b are such that $(a+3\sqrt{5})^2+a-b\sqrt{5}=51$. Find the possible values of a and the corresponding values of b. [6]

10 **(i)** Prove that $\sec x \operatorname{cosec} x - \cot x = \tan x$. [4]

(ii) Use the result from part **(i)** to solve the equation $\sec x \operatorname{cosec} x = 3\cot x$ for $0° < x < 360°$. [4]

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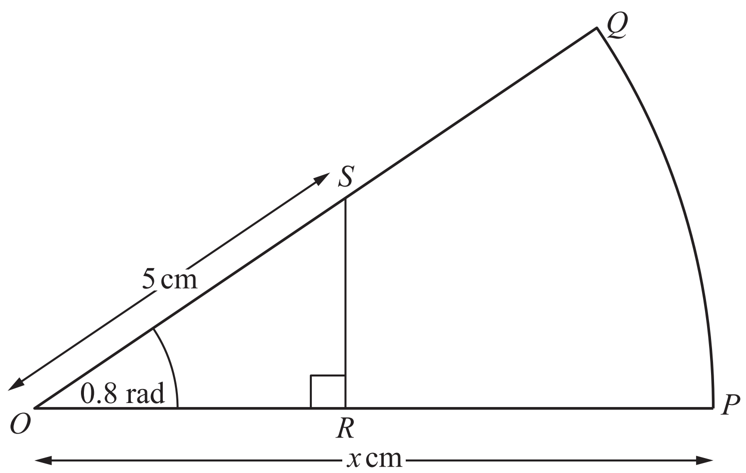


The diagram shows a sector OPQ of a circle with centre O and radius x cm. Angle POQ is 0.8 radians. The point S lies on OQ such that $OS = 5$ cm. The point R lies on OP such that angle ORS is a right angle. Given that the area of triangle ORS is one-fifth of the area of sector OPQ, find

(i) the area of sector OPQ in terms of x and hence show that the value of x is 8.837 correct to 4 significant figures, [5]

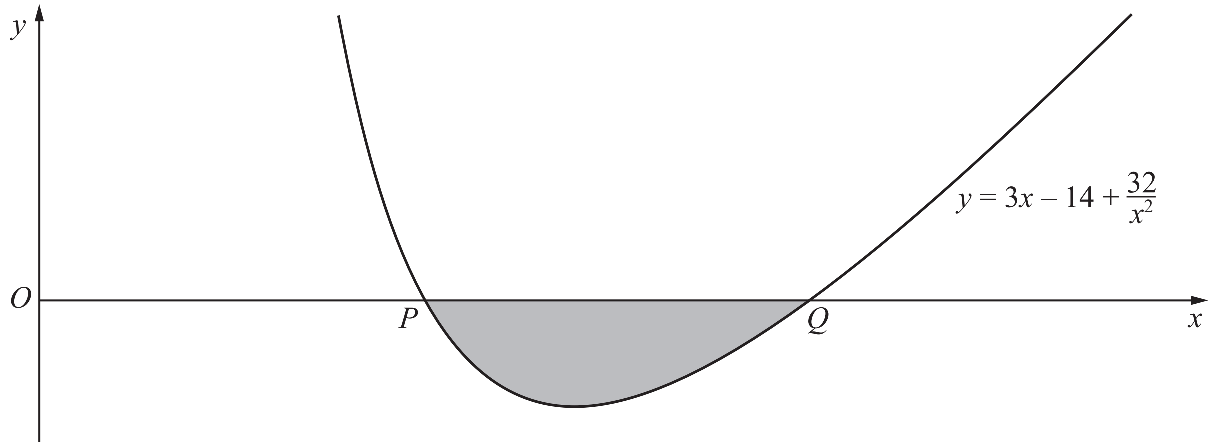
(ii) the perimeter of *PQSR*, [3]

(iii) the area of *PQSR*. [2]

12 **(i)** Show that $x-2$ is a factor of $3x^3-14x^2+32$. [1]

(ii) Hence factorise $3x^3-14x^2+32$ completely. [4]

The diagram below shows part of the curve $y = 3x - 14 + \dfrac{32}{x^2}$ cutting the x-axis at the points P and Q.



(iii) State the x-coordinates of P and Q. [1]

(iv) Find $\displaystyle\int \left(3x - 14 + \frac{32}{x^2}\right) \mathrm{d}x$ and hence determine the area of the shaded region. [4]

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