Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8475148912

ADDITIONAL MATHEMATICS **0606/22**

Paper 2 **February/March 2015**

2 hours

Candidates answer on the Question Paper.

Additional Materials: Electronic calculator

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 **16** printed pages.

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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 $\binom{n}{r} = \frac{n!}{(n-r)!r!}$

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

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

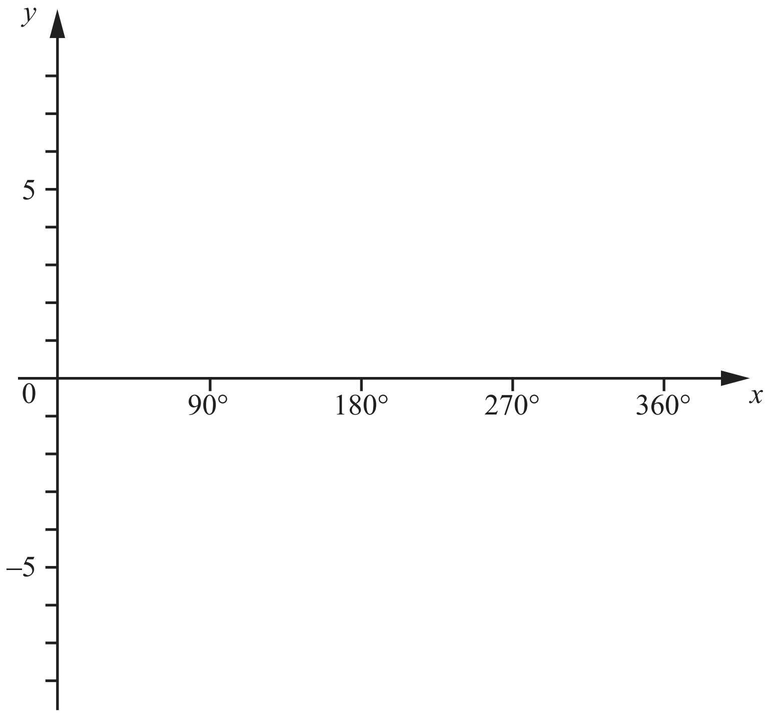
$$a^2 = b^2 + c^2 - 2bc \cos A$$

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

1 **(i)** State the amplitude of $4\cos x - 3$. [1]

(ii) State the period of $4\cos x - 3$. [1]

(iii) The function f is defined, for $0° \leqslant x \leqslant 360°$, by $\mathrm{f}(x) = 4\cos x - 3$. Sketch the graph of $y = \mathrm{f}(x)$ on the axes below. [2]



2 **(a)** Jean has nine different flags.

(i) Find the number of different ways in which Jean can choose three flags from her nine flags. [1]

(ii) Jean has five flagpoles in a row. She puts one of her nine flags on each flagpole. Calculate the number of different five-flag arrangements she can make. [1]

(b) The six digits of the number 738925 are rearranged so that the resulting six-digit number is even. Find the number of different ways in which this can be done. [2]

3 Solve the simultaneous equations

$$3x^2 - xy + 2y^2 = 16,$$
$$2y - x = 4.$$

[5]

4 **(i)** Differentiate $\sin x \cos x$ with respect to x, giving your answer in terms of $\sin x$. [3]

(ii) Hence find $\int \sin^2 x \, dx$. [3]

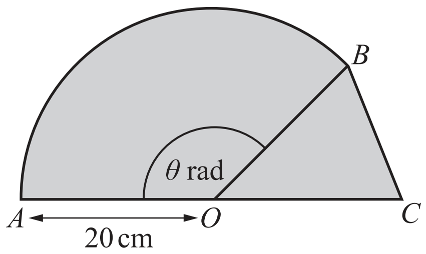
5 The position vectors of the points A and B relative to an origin O are $-2\mathbf{i} + 17\mathbf{j}$ and $6\mathbf{i} + 2\mathbf{j}$ respectively.

(i) Find the vector $\overrightarrow{AB}$. [1]

(ii) Find the unit vector in the direction of $\overrightarrow{AB}$. [2]

(iii) The position vector of the point C relative to the origin O is such that $\overrightarrow{OC} = \overrightarrow{OA} + m\overrightarrow{OB}$, where m is a constant. Given that C lies on the x-axis, find the vector $\overrightarrow{OC}$. [3]

6



AOB is a sector of a circle with centre *O* and radius 20 cm. Angle $AOB = \theta$ radians. *AOC* is a straight line and triangle *OBC* is isosceles with $OB = OC$.

(i) Given that the length of the arc *AB* is 15π cm, find the exact value of θ. [2]

(ii) Find the area of the shaded region. [4]

7 It is given that $\mathbf{A} = \begin{pmatrix} -1 & 5 \\ -3 & 10 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 3 & 5 \\ 4 & 10 \end{pmatrix}$.

(i) Find $\mathbf{A}^2 + \mathbf{B}$. [2]

(ii) Find det $\mathbf{B}$. [1]

(iii) Find the inverse matrix, $\mathbf{B}^{-1}$. [2]

(iv) Find the matrix $\mathbf{X}$, given that $\mathbf{BX} = \mathbf{A}$. [2]

8 Solutions to this question by accurate drawing will not be accepted.

The points A and B have coordinates $(2, -1)$ and $(6, 5)$ respectively.

(i) Find the equation of the perpendicular bisector of AB, giving your answer in the form $ax + by = c$, where a, b and c are integers. [4]

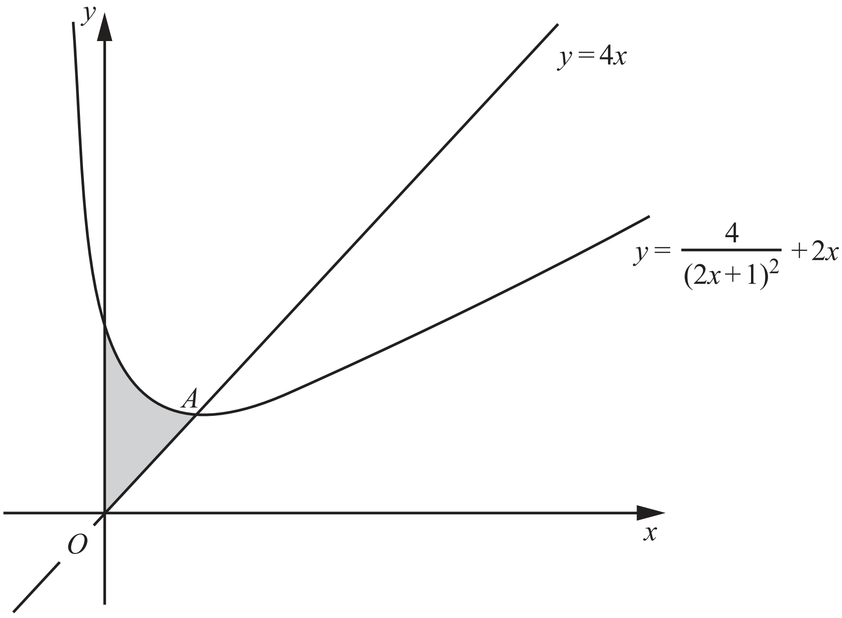
The point C has coordinates $(10, -2)$.

(ii) Find the equation of the line through C which is parallel to AB. [2]

(iii) Calculate the length of BC. [2]

(iv) Show that triangle ABC is isosceles. [1]

9



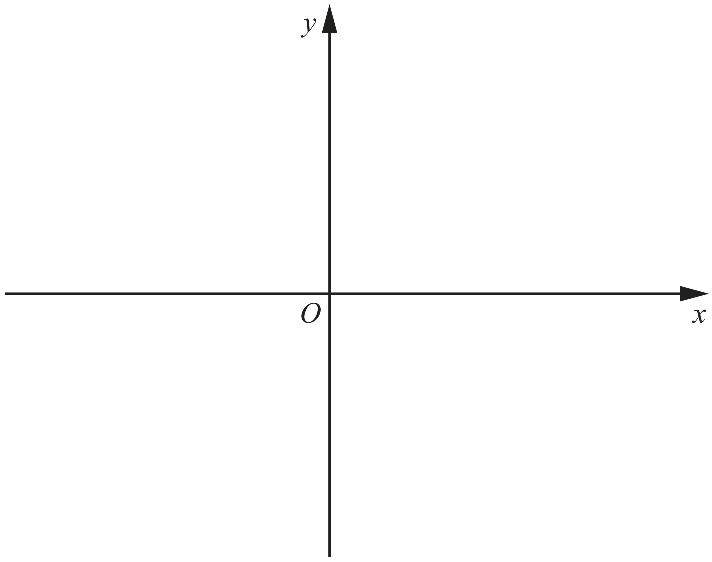
The diagram shows part of the curve $y = \dfrac{4}{(2x+1)^2} + 2x$ and the line $y = 4x$.

(i) Find the coordinates of A, the stationary point of the curve. [5]

(ii) Verify that A is also the point of intersection of the curve $y = \dfrac{4}{(2x+1)^2} + 2x$ and the line $y = 4x$. [1]

(iii) **Without using a calculator**, find the area of the shaded region enclosed by the line $y = 4x$, the curve and the y-axis. [6]

10 **(a)** **(i)** Sketch the graph of $y = e^x - 5$ on the axes below, showing the exact coordinates of any points where the graph meets the coordinate axes. [3]



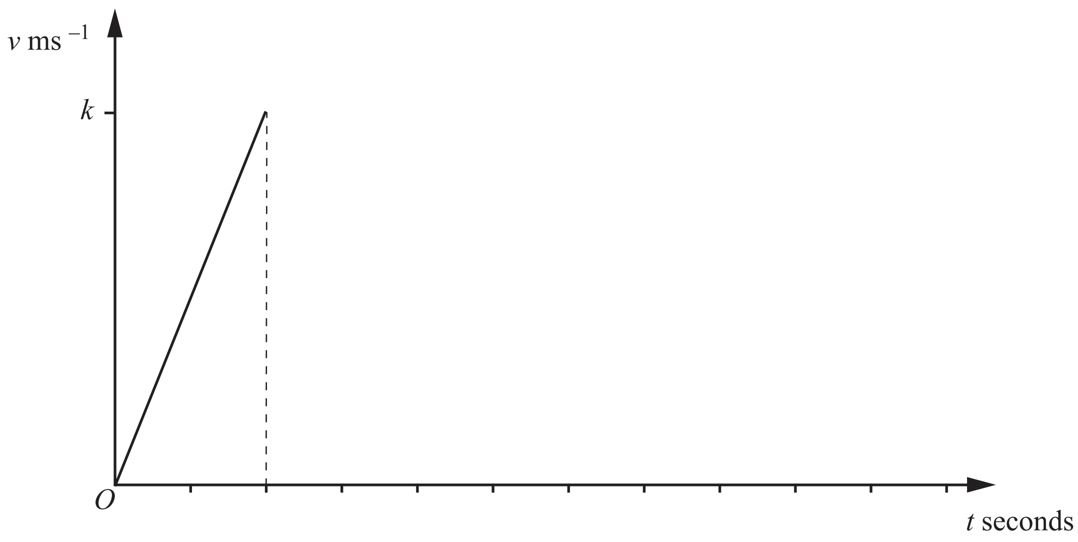
(ii) Find the range of values of k for which the equation $e^x - 5 = k$ has no solutions. [1]

(b) Simplify $\log_a \sqrt{2} + \log_a 8 + \log_a \left(\frac{1}{2}\right)$, giving your answer in the form $p \log_a 2$, where p is a constant. [2]

(c) Solve the equation $\log_3 x - \log_9 4x = 1$. [4]

11 **(a)** A particle P moves in a straight line. Starting from rest, P moves with constant acceleration for 30 seconds after which it moves with constant velocity, $k\,\text{ms}^{-1}$, for 90 seconds. P then moves with constant deceleration until it comes to rest; the magnitude of the deceleration is twice the magnitude of the initial acceleration.

(i) Use the information to complete the velocity-time graph. [2]



(ii) Given that the particle travels 450 metres while it is accelerating, find the value of k and the acceleration of the particle. [4]

Question 11(b) is printed on the next page.

(b) A body Q moves in a straight line such that, t seconds after passing a fixed point, its acceleration, $a\,\text{ms}^{-2}$, is given by $a = 3t^2 + 6$. When $t = 0$, the velocity of the body is $5\,\text{ms}^{-1}$. Find the velocity when $t = 3$. [5]