EXAMINATIONS COUNCIL OF ZAMBIA

Joint Examination for the School Certificate
and General Certificate of Education Ordinary Level

ADDITIONAL MATHEMATICS 4030/1

PAPER 1

Monday 28 OCTOBER 2013

Additional materials:
Answer Booklet
Graph paper(1 Sheet)
Mathematical tables/Electronic calculators

TIME: 2 hours

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces on the Answer Booklet provided.

There are **12 questions** in this paper. Answer all questions.

Write your answers in the Answer Booklet provided.

If you use more than one Answer Booklet, fasten the Answer Booklets together.

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.

INFORMATION FOR CANDIDATES

The number of marks is shown in brackets [ ] at the end of each question or part question. The total number of marks for this paper is 80.

The use of a non programmable electronic calculator is expected, where appropriate. Cell phones should not be brought in the examination room.

You are reminded of the need for clear presentation in your answers.

Check the formulae overleaf.

This question paper consists of 5 printed pages.

MATHEMATICS FORMULAE

1 ALGEBRA

Quadratic Equation

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

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

Binomial Theorem

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

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

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

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

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

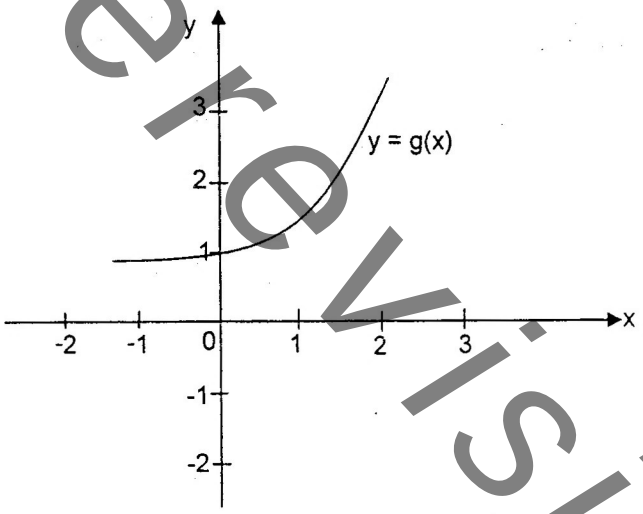
1 Find the coordinates of the point of intersection of the straight line $y - 2x = 3$ and the curve $xy = 2$. [5]

2 A, B and C are points on the coordinate plane. The coordinates of B and C are (8, 6) and (6, –1) respectively. Given that the midpoint of AB is (5, 1), find the length of AC. [4]

3 (a) A function f is defined by

$f: x \longrightarrow \frac{4}{x-1}$, for $x \neq 1$. Find f^2. [2]

(b) The diagram below shows the sketch of a function g(x).



Copy the diagram and sketch on it the function $g^{-1}(x)$. [2]

(c) {(12, 14), (13, 5), (x, 13)} is a set of objects and images for the relation h. State the values that x should **not** take if h is a function. [2]

4 Express $5 + x - 5x^2$ in the form $a(x + b)^2 + c$. Hence or otherwise find the maximum value of $f(x) = 5 + x - 5x^2$. [4]

5 (a) Find the term independent of x in the expansion of $\left(2x^3 + \frac{1}{x}\right)^{12}$. [4]

(b) The first three terms in the expansion of $(1 + ax)^n$ in ascending powers of x are $1 - 12x + 63x^2$. Find the values of a and n. [5]

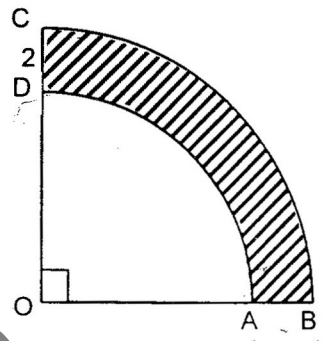
8 Prove the identity

$\cos^2\theta - \frac{1}{\sec^2\theta - 1} \equiv -\cot^2\theta\cos^2\theta$. [4]

9 Sketch the graph of $y = |\cos x - 1|$ for the domain 0 to 2π. Hence or otherwise state the maximum value of $y = |\cos x - 1|$. [5]

8 **(a)** The ratio of the radius to the arc length of a sector is 2:5.
Find the angle in radians of the sector. [2]

(b) AD and BC are arcs of concentric circles, centre O. ∠AOD is a right angle, the area of the shaded region is $9\pi cm^2$ and CD = 2cm.



(i) Find the length of OD. [3]

(ii) Determine the perimeter of the shaded region. [2]

9 The vectors $\underline{a} = 3i + kj$ and $\underline{b} = ci + 5j$ are such that $\underline{a} \cdot \underline{b} = 3$. The unit vector in the direction of $\underline{a}$ is $\hat{} 3i + pj$, where $p > 0$. Find

(a) the value of p, [2]

(b) an equation connecting k and c, [2]

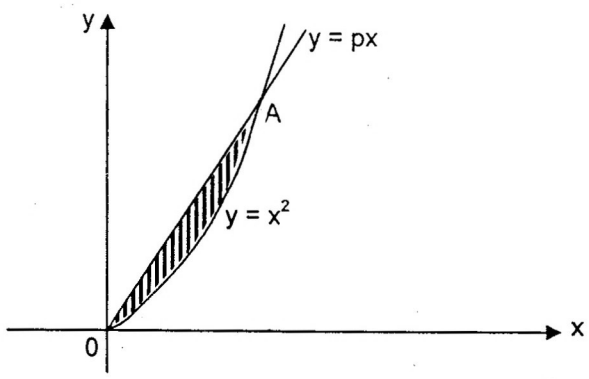
(c) the values of k and c. [3]

10 **(a)** Given that $y = (3x - 1)^4$, find the value of x for which $\frac{dy}{dx} = 12$. [3]

(b) Determine the value of y after x decreases from 3 to 2.98 in the function $y = 3x^2 - 2x + 4$. [6]

11 **(a)** Given that $\int\left(x^3 + \frac{a}{x^2}\right)dx = \frac{bx^4}{5} + \frac{2}{x}$, find the values of a and b. [4]

(b) The diagram below shows part of the curve $y = x^2$ intersecting the line $y = px$ at (0,0) and A.



Find

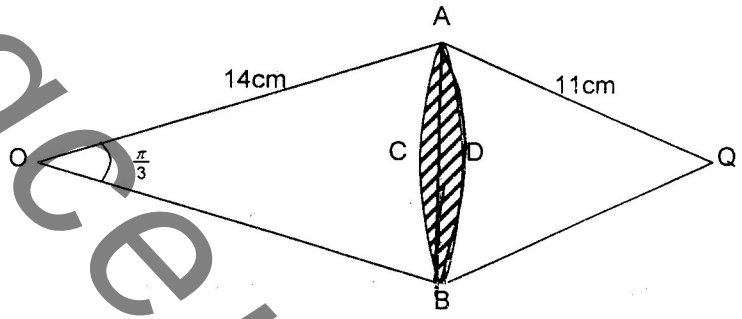
(i) the coordinates of A in terms of p, [2]

(ii) the value of p for which the area of the shaded region is 36 square units. [4]

12 Answer only one of the following alternatives:

Either

In the diagram below, OADB is a sector of a circle with centre O and radius 14cm. QACB is a sector of a circle with centre Q and radius 11cm. $\angle AOB = \frac{\pi}{3}$ radians.



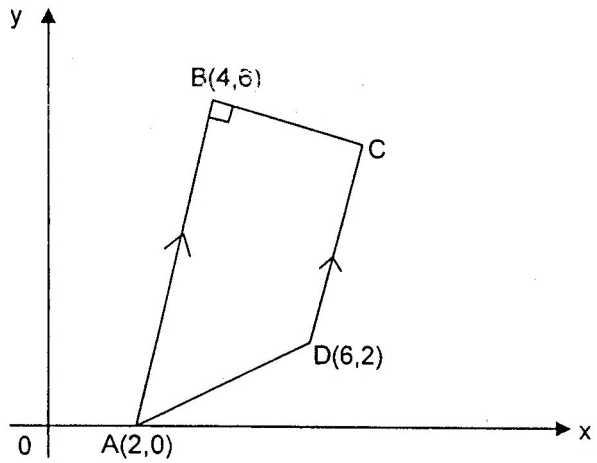
Find

(a) $\angle AQB$, [4]

(b) the area of the shaded region. [6]

Or

The diagram below shows a trapezium ABCD in which A is the point (2, 0), B is (4, 6) and D is (6, 2). $\angle ABC = 90°$ and AB is parallel to DC.



Find

(a) the coordinates of C, [6]

(b) the area of the trapezium. [4]