Name: _____ ( ) Class: _____

PRELIMINARY EXAMINATION
GENERAL CERTIFICATE OF EDUCATION ORDINARY LEVEL

ADDITIONAL MATHEMATICS 4047/01

Paper 1 **Friday 18 August 2017**

2 hours

Additional Materials: Answer Paper

READ THESE INSTRUCTIONS FIRST

Write your name, class, and index number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a pencil for any diagrams or graphs.
Do not use paper clips, highlighters, glue, or correction fluid.

Answer **all** the questions.
Write your answers on the separate Answer Paper provided
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 approved scientific calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

At the end of the examination, staple all your work together with this cover sheet.
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**.

FOR EXAMINER'S USE

Q1		Q6		Q11	
Q2		Q7		Q12	
Q3		Q8		Q13	
Q4		Q9			
Q5		Q10			

80

This document consists of **6** printed pages.

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

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

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!r!} = \frac{n(n-1).....(n-r+1)}{r!}$

2. TRIGONOMETRY

Identities

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

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

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

$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$

$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$

$$\tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A \tan B}$$

$$\sin 2A = 2\sin A \cos A$$

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

$$\tan 2A = \frac{2\tan A}{1 - \tan^2 A}$$

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 The mass of a radioactive substance reduces by half every 4 hours. It is given that m_0 is the mass of the substance at a particular time and that m is the mass of the substance t hours later. Calculate the value of the constant k in the relationship $m = m_0 e^{-kt}$. [3]

2 Solve the equation $3^{2x+1} - 6\left(3^x\right) = 27 - 2\left(3^{2x}\right)$. [4]

3 The function f is defined, for all values of x, by $\mathrm{f}(x) = x^2 e^x$.
Find the range of values of x for which f is a decreasing function. [6]

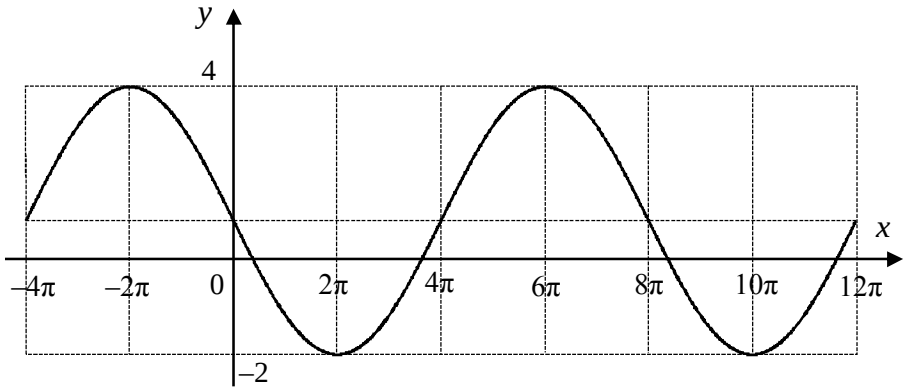
4 **(i)** On the same diagram, sketch the curves $y = 2x^{\frac{1}{3}}$ and $y = 8x^{-\frac{1}{3}}$. [2]

(ii) Find the coordinates of the intersection points of the two curves. [3]

5 The equation of a curve is $y = \dfrac{x-8}{5-2x}$. A particle moves along the curve in such a way that the y-coordinate of the particle is decreasing at a constant rate of 2 units per second. Find the possible y-coordinates of the particle at the instant when the x-coordinate of the particle is increasing at $1\dfrac{7}{11}$ units per second. [6]

6 A curve has equation $y^2 = -4x$ and a line has equation $y = m(x-1)$. Find the range of values of m for which the line $y = m(x-1)$ intersects the curve $y^2 = -4x$ at two distinct points. [5]

7



The diagram shows part of the graph of $y = a\sin\left(\frac{x}{b}\right) + c$.

(i) State the amplitude and period. [2]

(ii) Find the value of each of the constants *a*, *b* and *c*. [3]

8 **(i)** Sketch the graph of $y = 4 - |x|$. [2]

A line of gradient *m* passes through the point (0, 1).

(ii) In the case where $m = -2$, find the coordinates of any point of intersection of the line and the graph of $y = 4 - |x|$. [3]

(iii) Determine the set of values of *m* for which the line intersects the graph of $y = 4 - |x|$ at one point. [2]

9 **(i)** Prove that $\tan A + \frac{\cos A}{1 + \sin A} = \sec A$. [3]

(ii) Hence, find the exact solutions of $\tan 2x + \frac{\cos 2x}{1 + \sin 2x} = \operatorname{cosec} x$ for $0 \le x \le 2\pi$. [5]

10 A particle, moving in a straight line, passes through a fixed point *O* with a velocity of 3 m/s . The acceleration, a m/s^2, of the particle, t seconds after passing through *O* is given by $a = -0.6e^{0.2t}$.

(i) Find the value of *t* when the particle is at instantaneous rest. [4]

(ii) Find the distance travelled by the particle in the first 5 seconds. [4]

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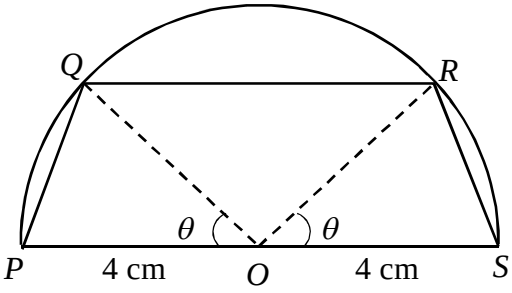
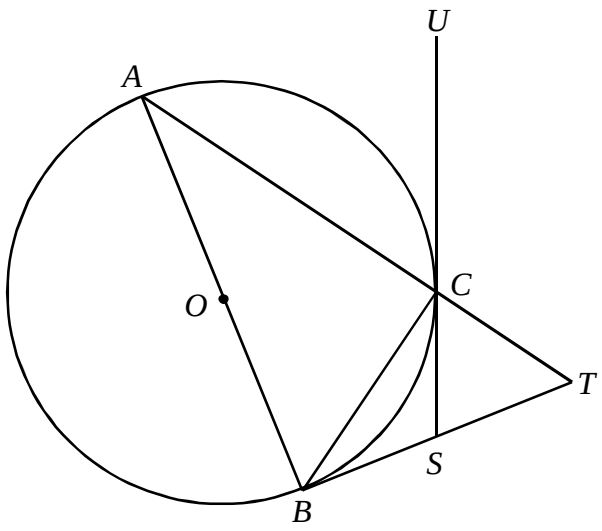


The diagram shows a trapezium *PQRS* inscribed in a semicircle with centre *O*. The radius of the semicircle is 4 cm. Angle *POQ* = angle *SOR* = θ radians.

(i) Show that the area, A cm^2, of the trapezium *PQRS* is given by $A = 16\sin\theta + 8\sin 2\theta$. [2]

(ii) Given that θ can vary, find the value of θ for which the area of the trapezium is a maximum. [6]

12



In the diagram, *AB* is a diameter of the circle with centre *O*. *CS* and *BT* are the tangents to the circle at *C* and *B* respectively. *UCS*, *ACT* and *BST* are straight lines. Prove that

(i) triangle *ABC* and triangle *ATB* are similar, [2]

(ii) angle *SCT* = angle *CTS*, [3]

(iii) *S* is the midpoint of *BT*. [2]

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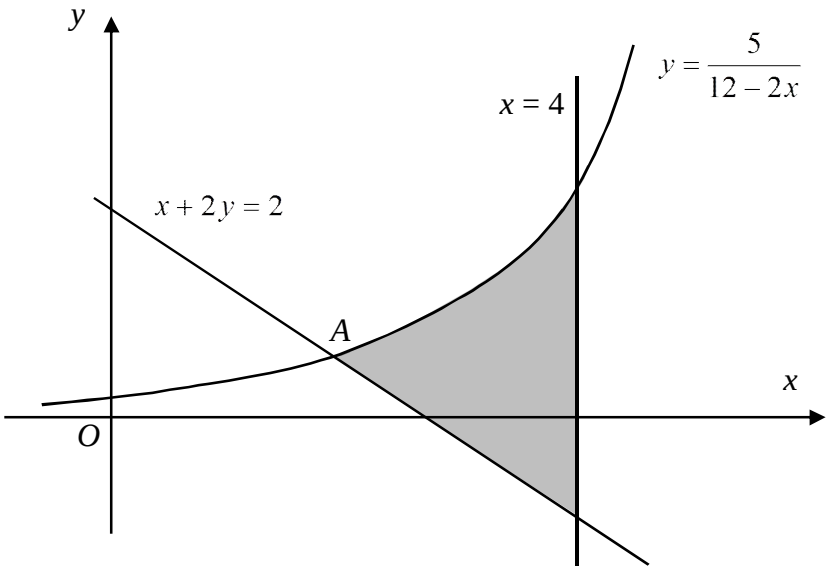

The diagram shows part of the curve $y = \frac{5}{12 - 2x}$ and the line $x + 2y = 2$.

The line intersects the curve at point *A*.

(i) Find the coordinates of *A*. [3]

(ii) Find the area of the shaded region bounded by the curve $y = \frac{5}{12 - 2x}$,

the lines $x = 4$ and $x + 2y = 2$. [5]

End of Paper.