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MINISTRY OF EDUCATION, SINGAPORE
in collaboration with
UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER | S | | | | |

INDEX NUMBER | | | | |

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ADDITIONAL MATHEMATICS

4047/01

Paper 1

October/November 2019

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number and name in the spaces at the top of this page.
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 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, 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 **19** printed pages and **1** blank page.

Singapore Examinations and Assessment Board

CAMBRIDGE International Examinations

DC (KS/TP) 163309/3

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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 expansion

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

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

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 Given that θ is acute and $\cos\theta = c$, express, in terms of c,

(i) $\tan\theta$, [3]

(ii) $\operatorname{cosec}\theta$. [1]

2 Find the set of values of the constant k for which the curve $y = x^2 + (2k+1)x + 1$ lies entirely above the line $y = x$. [4]

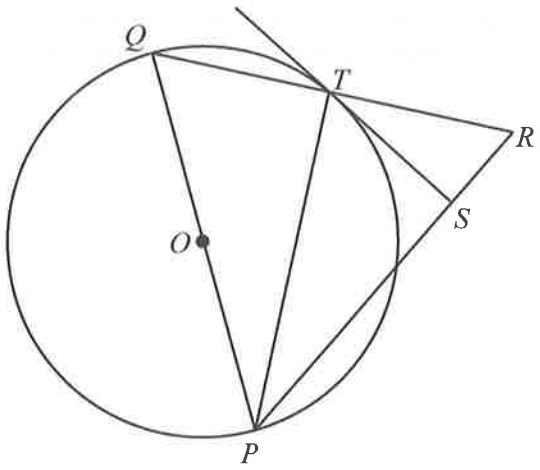
3 Given that $y = Ae^{2x} + Be^{-x}$, and that $\frac{dy}{dx} + 4y = e^{2x} - e^{-x}$, find the value of each of the constants A and B. [4]

4 An ice cube of side x cm is melting in such a way that the total surface area, $A\,\text{cm}^2$, is decreasing at a constant rate of $48\,\text{cm}^2/\text{s}$. Assuming that the cube retains its shape, calculate the rate of change of x when $x = 10$. [4]

5 **(i)** A manufacturer produces a disinfectant that destroys 21% of all known germs within one minute of use. If N is the number of germs present when the disinfectant is first used, and assuming germs continue to be destroyed at the same rate, explain why the number of germs expected to be alive after n minutes is given by $(0.79)^n N$. [2]

(ii) The manufacturer decides to advertise by stating that the disinfectant destroys x% of all known germs within 20 minutes of use. Calculate, to 2 significant figures, the value of x. [2]

(iii) Given that the number of germs expected to be alive after n minutes can be expressed as Ne^{kn}, find the value of the constant k. [2]



In the diagram, PQ is the diameter of a circle, centre O. Triangle PQR is an isosceles triangle with $PQ = PR$. The line QR intersects the circle at T. The tangent to the circle at T meets PR at S.

(i) Show that angle $TSR = 90°$. [5]

(ii) Explain why the circle passing through the points S, R and T has its centre at the midpoint of TR. [2]

7 **(i)** Write down and simplify the first three terms in the expansion, in ascending powers of x, of $\left(2-\frac{x}{8}\right)^6$. [3]

(ii) In the expansion of $(4+kx+x^2)\left(2-\frac{x}{8}\right)^6$, the sum of the coefficients of x and x^2 is zero. Find the value of the constant k. [4]

8 The equation of a curve is $y = x + \frac{2x+5}{x-2}$.

(i) Find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$. [3]

(ii) Find the x-coordinate of each of the stationary points of the curve. [3]

(iii) Find the nature of each stationary point. [2]

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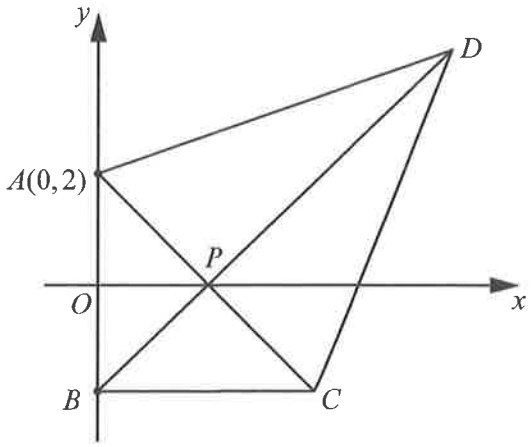

The diagram shows a kite $ABCD$ in which $AB = BC$ and $AD = DC$. The points $A(0, 2)$ and B lie on the y-axis. The diagonals AC and BD intersect at the point P on the x-axis.
Given that the length of AB is 4 units,

(i) explain why BC is parallel to the x-axis, [2]

(ii) find the coordinates of C. [1]

Given further that the area of the kite is 28 units^2,

(iii) find the coordinates of D. [5]

10 **(a)** Find the values of x and y which satisfy the equations

$$3^{x+y} = \sqrt[3]{27},$$
$$\frac{4^y}{2^x} = \left(\frac{1}{2}\right)^{-3}.$$

[4]

(b) A circular cylinder of volume $(3\sqrt{7}-6)\pi$ cm^3 has a height of $(2+\sqrt{7})$ cm and a radius of r cm. Without using a calculator, obtain an expression for r^2 in the form $(a+b\sqrt{7})$, where a and b are integers. [4]

11 A dot on a computer screen moves in a straight line so that, t seconds after leaving a fixed point O, its displacement, s cm, from O is modelled by $s = t^3 - 6t^2 + 9t$.

(i) Find the values of t at which the dot is instantaneously at rest. [3]

(ii) Find the acceleration of the dot when it first comes to instantaneous rest. [2]

(iii) Explain clearly why the total distance travelled by the dot in the interval $t = 0$ to $t = 4$ is **not** obtained by finding the value of s when $t = 4$. [2]

(iv) Find the total distance travelled by the dot in the interval $t = 0$ to $t = 4$. [3]

12 It is given that $f(x) = 2\sin 2x$ and $g(x) = 3\cos\left(\frac{x}{2}\right) - 1$.

(i) State the least and greatest values of $f(x)$. [1]

(ii) State the least and greatest values of $g(x)$. [2]

(iii) State the period of $f(x)$. [1]

(iv) State the period of $g(x)$. [1]

(v) Sketch, on the same axes, the graphs of $y = f(x)$ and $y = g(x)$ for $0° \leqslant x \leqslant 360°$. [4]

(vi) State the number of solutions of the equation $2\sin 2x + 1 = 3\cos\left(\frac{x}{2}\right)$ for $0° \leqslant x \leqslant 360°$. [1]

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