PEICAI SECONDARY SCHOOL
SECONDARY 4 NORMAL ACADEMIC
PRELIMINARY EXAMINATION 2020

CANDIDATE NAME

CLASS | | | REGISTER NUMBER | |

ADDITIONAL MATHEMATICS **4044/01**

Paper 1

14 August 2020

1 hour 45 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your register number, class 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 70.

This document consists of **17** printed pages and **3** blank pages.

Setter: Mr. Francis Tan

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

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

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

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 Find the area of the quadrilateral with vertices at $A(-2,1)$, $B(1,3)$, $C(6,-1)$ and $D(2,-4)$. [2]

2 Sketch the graph of $y=3\sin 2x-1$ for $0^{\circ} \leq x \leq 180^{\circ}$. [3]

3 Solve $(x-3)(x^2+2x+3)=x^3-2x-15$. [4]

4 Prove that $\operatorname{cosec} 2x + \cot 2x = \cot x$. [4]

5 The equation of the tangent at point $P(4,8)$, on the parabola $y^2 = 16x$ is $y = x + 4$.

(i) Find the equation of the normal to the parabola at *P*. [3]

The normal to the parabola at *P* intersects the parabola again at point *Q*.

(ii) Find the coordinates of *Q*. [3]

6 **(a)** Solve $(2^x)^{2x} = 256$. [2]

(b) Simplify $\left(3z^3\right)^{\frac{4}{3}}\left(\sqrt[5]{243z}\right)^{-2}$, giving your answer in the form $3^a \times z^b$, where a and b are constants. [3]

7 A and B are angles in the same quadrant such that $\sin A = \frac{5}{13}$ and $\cos B = -\frac{4}{5}$. Find the values of the following.

(i) $\cot B$ [2]

(ii) $\sin(A - B)$ [3]

8 Differentiate the following with respect to x.

(i) $\left(2x^3 - 5x + 7\right)^{-3}$ [2]

(ii) $\dfrac{2 - x^2}{x^2 + 1}$ [3]

9 Factorise $27x^3 + 125$ and hence prove that $27x^3 + 125 = 0$

has only one real solution. [5]

10 **(i)** Write $15\cos\theta - 8\sin\theta$ in the form $R\cos(\theta + \alpha)$, where $R > 0$ and $0^\circ \leq \alpha \leq 90^\circ$. [4]

(ii) Hence state the least value of $15\cos\theta - 8\sin\theta$ and the corresponding value of θ, where $60^\circ \leq \theta \leq 270^\circ$. [4]

11 **(i)** Find, in exact form, the coordinates of the stationary points of the curve

$$y = -x^3 + 12x - 5$$

and determine the nature of the stationary points. [6]

(ii) Find the equation of the normal to the curve at the point $(0, -5)$. [2]

12 The function $\mathrm{f}(x)$ is defined by $\mathrm{f}(x) = x^3 + ax^2 + bx - 12$ for all real x. Given that $x+2$ is a factor of of $\mathrm{f}(x)$, and when $\mathrm{f}(x)$ is divided by $x-3$ the remainder is 30,

(i) find the value of a and b. [4]

(ii) Factorise $f(x)$ completely. [3]

13 The height, h meters, of the waves during the high tide at a beach is given by

$$h = 3 + A\sin(kt + p)$$

where t is the time in hours after 0800 and A, k and p are constants, where $0 \le p < \pi$.

At 0800, the height of the wave is 3m. At its peak, the height of the waves can reach up to 5m.

(i) Show that $h = 3 + 2\sin(kt)$ [5]

(ii) Explain why the height of the waves would never be 0 m. [1]

The period of the height of the waves is $\frac{\pi}{4}$.

(iii) Using your answer in part **(i)**, find the value of k. [2]

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