PEICAI SECONDARY SCHOOL
SECONDARY 4 NORMAL ACADEMIC
PRELIMINARY EXAMINATION 2020

CANDIDATE NAME

CLASS

REGISTER NUMBER

ADDITIONAL MATHEMATICS **4044/02**

Paper 2

17 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 **16** printed pages.

Setter: Mr. Francis Tan

[Turn over

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 Δ ABC

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

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

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

1 Find the term independent of x in the expansion of $\left(x^2 + \frac{1}{2x^3}\right)^{10}$. [4]

2 Given that $\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{9x}{\sqrt{4x^2 - 3}}$, find the value of the constant k such that

$\frac{\mathrm{d}^2 y}{\mathrm{d}x^2} = \frac{k}{\left(4x^2 - 3\right)^{\frac{3}{2}}}$. [5]

3 Solve $\left(\sqrt{3}-2\right)x+\sqrt{3}=2\sqrt{3}x+1$, giving your answers in the form $a+b\sqrt{3}$, where a and b are integers. [5]

4 The roots of the quadratic equation $2x^2 - 4x + 3 = 0$ are α and β.

(i) Evaluate $\alpha^2 + \beta^2$. [4]

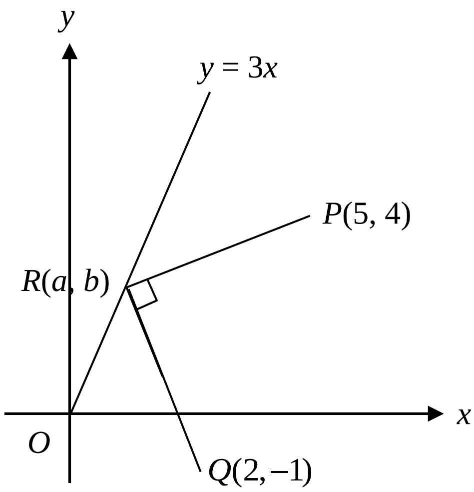
(ii) Hence, show that $\alpha^3 + \beta^3 = -1$. [2]

(iii) Find the quadratic equation whose roots are α^3 and β^3. [3]

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

(a) The diagram shows points $P(5, 4)$ and $Q(2, -1)$. A point $R(a, b)$ lies on the line

$y = 3x$ such that angle PRQ is a right angle.

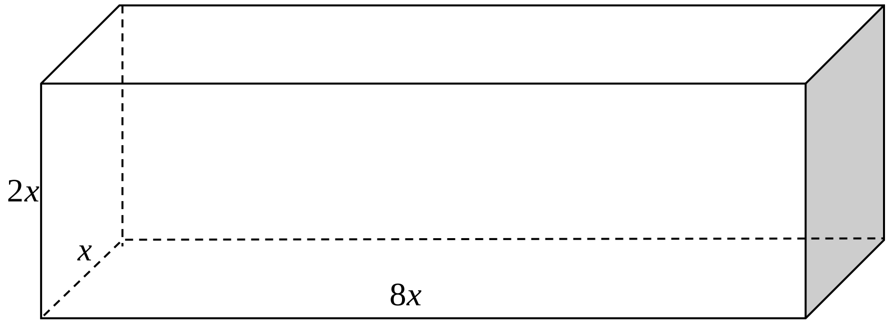


(i) Find the equation of the perpendicular bisector of PQ. [3]

(ii) Find the values of *a* and of *b*. [3]

(b) Find $\int \frac{x^2 - 2}{x^2}\, dx$. [3]

6 The diagram shows a shrinking ice block with a horizontal rectangular base x cm by $8x$ cm and four vertical sides of height $2x$ cm.



The volume of the ice block is decreasing at a rate of 24 cm^3/s. Determine the rate of decrease of x when $x = 3$ cm. [5]

7 The points $A(-4,-2)$, $B(2,6)$ and $C(2,-2)$ lie on a circle, C_1 with AB as the diameter.

(i) Find the equation of the tangent at A. [4]

(ii) Find the equation of the circle, C_1. [3]

The diameter through C meets the circle, C_1, again at D.

(iii) Find the coordinates of D. [2]

Another circle, C_2, has center $(2, 0)$ and radius 3.

(iv) State the equation of the circle, C_2. [1]

The circle, C_2 is reflected about the y axis.

(v) Find the equation of the reflected circle. [2]

8 The function $f(x)$ is defined by $f(x) = (2x+1)^2(1-x)+k$ for all real values of x, where k is a constant. Find the range of values of x for which $f(x)$ is an increasing function. [5]

9 Solve the simultaneous equations

$$x^2 - xy + y^2 - 7 = 0$$
$$y - 3x + 7 = 0$$

[5]

10 **(a)** **(i)** Given that $\dfrac{\sin(A+B)}{\sin(A-B)} = \dfrac{3}{5}$, show that $\tan A \cot B = -4$. [2]

(ii) Hence solve, for $0^\circ \leq A \leq 360^\circ$, the equation

$$\frac{\sin(2A+30^\circ)}{\sin(2A-30^\circ)} = \frac{3}{5}.$$ [4]

[Question 10 (b) is printed on the next page]

(b) Solve, for $0^\circ \le x \le 360^\circ$, the equation

$$2\cot x = 1 + \tan x.$$ [5]

~The End~