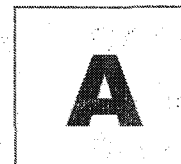


Name:		Index Number:		Class:	
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CATHOLIC HIGH SCHOOL
Preliminary Examination
Secondary 4 (O-Level Programme)



Additional Mathematics

4049/01

Paper 1

14 September 2021

2 hours 15 minutes

Additional Materials: Answer Booklets A and B

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions in the space provided

If working is needed for any question, it must be shown with the answer.

Omission of essential working will result in loss of marks.

The use of an approved scientific calculator is expected, where appropriate.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to **three significant figures**.

Give answers in **degrees to one decimal place**.

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is **90**.

For examiner's use:

Q1	Q2	Q3	Q4	Q5	Q6	Total Marks
/ 9	/ 11	/ 9	/ 8	/ 8	/ 5	/ 50

This booklet consists of **12** printed pages.

Mathematical Formulae**1. ALGEBRA***Quadratic Equation*

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

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

Binomial Expansion

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

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

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

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

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

$$\Delta = \frac{1}{2} ab \sin C$$

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1. (a) Without using tables or calculator, find the value of k such that

$$\left(\frac{10}{\sqrt{15}} - \frac{\sqrt{243}}{3\sqrt{5}} + \frac{20}{\sqrt{180}}\right) \times \frac{3}{\sqrt{5}} = 2 + k\sqrt{3}.$$

[3]

- (b) Given that $\log_4 xy = 7$ and $\frac{\log_4 x}{\log_4 y} = -8$, find the value of $\log_4 y$.

Hence, evaluate $\log_4 \frac{2x}{y^3}$. [6]

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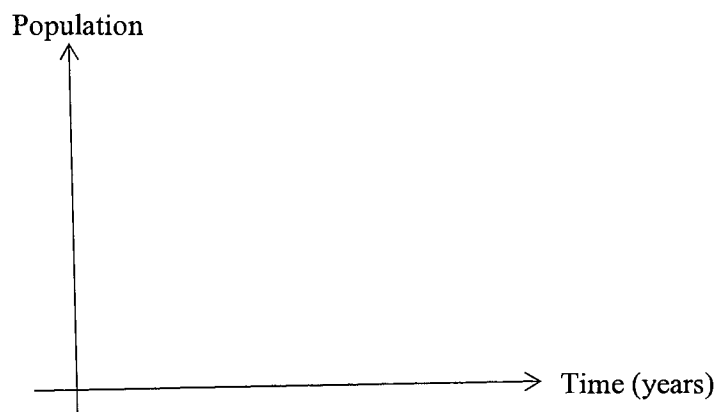
2. The population of polar bears in the arctic is given by the formula $N = 8000(2 + 3e^{-\frac{t}{50}})$, where t is measured in years. Find
- (i) the initial population, [1]
- (ii) the population after 50 years, [1]
- (iii) the least number of years it would take the population to exceed 20 000, [3]

- (iv) the rate at which the polar bears is decreasing when $t = 10$, [2]

- (v) From the formula $N = 8000(2 + 3e^{-\frac{t}{50}})$, explain why the population of the polar bears can never fall below 16000. [2]

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- (vi) Sketch the population-time curve in the grid below. [2]



3. Given that the expression $2x^3 + ax^2 + bx - 6$ is divisible by $(x^2 - 2)$, find the value of a and of b . [4]

Hence,

- (i) solve the equation $2x^3 + ax^2 + bx - 6 = 0$, for the exact value(s) of x , [3]

- (ii) solve the equation $2 + ay + by^2 - 6y^3 = 0$. [2]

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4. (a) Solve $2 \sin x = \tan x$ for which $0^\circ \leq x \leq 360^\circ$. [4]

- (b) Find all the angles between 0 and π for which $2 \tan y (\tan y + 1) = 3(2 - \sec^2 y)$. [4]

5. (a) Given that $\cos A = -\frac{3}{5}$ where $\pi < A < \frac{3\pi}{2}$. Find, without using a calculator, the value of

(i) $\sin(\pi - A)$, [1]

(ii) $\cot A$, [1]

(iii) $\cos \frac{A}{2}$. [2]

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(b) Prove the identity

$$\frac{2 - \sec^2 x}{\sec^2 x + 2 \tan x} \equiv \frac{\cos x - \sin x}{\cos x + \sin x}$$

[4]

- 6 The function h is defined, for $0^\circ \leq x \leq 360^\circ$, by $h(x) = a \cos(bx) + c$, where a , b and c are positive integers. Given that the greatest and least values of h are 3 and -1 respectively and the period of h is 720° ,

(i) state the value of a , of b and of c . [3]

(ii) Sketch the graph of h . [2]

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