Name:	Index Number:	Class:

HUA YI SECONDARY SCHOOL

4E

Preliminary Examination

4E

ADDITIONAL MATHEMATICS

4049/1

Paper 1

15 September 2021

2 hours 15 minutes

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

READ THESE INSTRUCTIONS FIRST

Write your Name, Class and Index Number in the spaces provided at the top of this page.
Write your answers in the spaces provided on the question paper.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.

Answer **all** 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.

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 82.

For Examiner's Use
82

This document consists of **16** printed pages including the cover page.

[Turn Over

Setter: Ms Elene Phang

Mathematical Formula

1. ALGEBRA

Quadratic Equation

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

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

Binomial Theorem

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

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

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

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

$$\cos ec^2 A = 1 + \cot^2 A$$

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

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

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

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

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

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

Formulae for ΔABC

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

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

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

1 The line $5y = 12x + 15$ intersects the curve $\frac{x^2}{5} + \frac{y}{3} = 2$ at point A and B. Find the length of AB. [6]

2 In a wave pool, the height of a wave y meters, can be modelled by $y = 2.5 - \cos 2x$, where x represents the horizontal distance of the wave in meters.

(a) Sketch the graph $y = 2.5 - \cos 2x$ for $0 \leq x \leq \pi$. [3]

(b) Solve $2.5 - \cos 2x = 1.8$. [2]

(c) A surfer can catch and ride on a wave when it is about 1.8 m in height. Find the horizontal distance that the surfer can ride on the wave before it breaks. [2]

3 Caesium-137 (Cs-137) is a radioactive isotope which will decay to half its original amount in 30 years. The amount of Cs-137 left, A mg, is given by the formula $A = 200e^{kt}$, where t is the time in years.

(a) Find the initial mass of the sample of Cs-137. [1]

(b) Find the value of k. [2]

(c) What percentage of the sample has decayed after 50 years? [3]

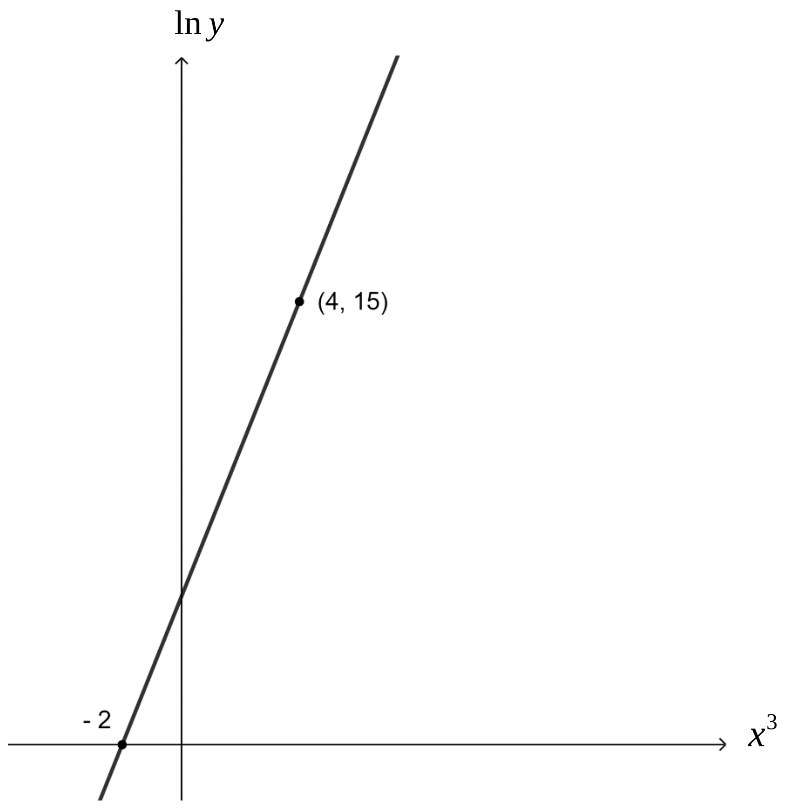
4 Express $\dfrac{5x^3+3x^2+11x+8}{x^3+2x}$ in partial fractions. [6]

5 A curve with equation $y=(4x-9)\sqrt{x^2+4}$ crosses the x-axis at point C.

(a) Find $\dfrac{dy}{dx}$ and express your answer in the form of $\dfrac{ax^2+bx+c}{\sqrt{x^2+4}}$.
Hence, find the gradient of the curve at C. [5]

(b) Hence determine the angle that the tangent to the curve at C makes with the positive x-axis. [2]

6 **(a)** The figure below shows part of a straight line obtained by plotting $\ln y$ against x^3 and it passes through the horizontal axis at – 2 and $(4, 15)$.



Express y in terms of x. [4]

(b) Find the value of x when $y = 11150$. [2]

7 Given that $\sqrt{p-\sqrt{q}} = \dfrac{2}{\sqrt{5}+\sqrt{3}}$ where p and q are integers. Without using a calculator, find the value of p and of q. [4]

8 **(a)** Prove the identity $\dfrac{\tan^2 x}{1-\sec x}+1=-\sec x$. [3]

(b) Hence, solve $\dfrac{\tan^2 x}{1-\sec x}=\dfrac{1}{2}$ for $0 \le x \le 360°$. [4]

9 **(a)** Express each of $2x^2+4x+22$ and $-x^2-6x-7$ in the form $a(x+b)^2+c$ where *a*, *b* and *c* are constants. [4]

(b) Use your answers from (a) to explain why the curves $y=2x^2+4x+22$ and $y=-x^2-6x-7$ will not intersect. [3]

10 A particle travels in a straight line so that, t seconds after passing a fixed point O, its velocity v m/s is given by $v = 3t^2 - 19t + 26$.

(a) Find the initial acceleration. [2]

(b) Find the values of t when the particle is instantaneously at rest. [2]

(c) Show that the particle will not return to the fixed point *O*. [5]

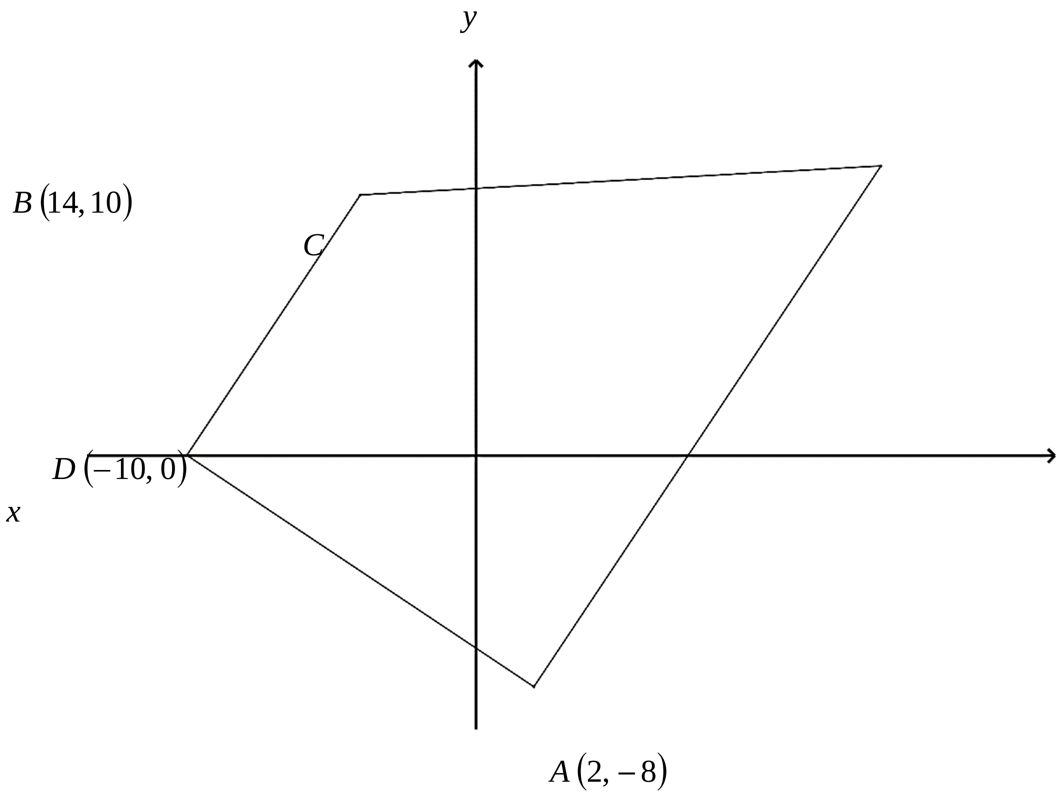
11 **(a)** Solve the equations

(i) $2\log_4(x-6)+\log_2(x+6)=\dfrac{1}{\log_5 2}+\log_2 x$. [4]

(ii) $13^{x-1} = 7^{2-x} \times 3$. [3]

(b) Show without using a calculator $10^{\frac{\lg 5}{2}} = \sqrt{5}$. [2]

12 In the diagram below, it is given that *AB* is parallel to *CD*, *AD* is perpendicular to *AB*. $A=(2,-8)$, $B=(14,10)$, $D=(-10,0)$ and *C* lies on the perpendicular bisector of *AB*.



(a) Find the equation of *CD*. [2]

(b) Find the coordinates of *C*. [4]

(c) Calculate the area of quadrilateral *ABCD*. [2]

End of Paper