Class/ Index Number	Centre Number/ 'O' Level Index Number	Name
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新加坡海星中学

MARIS STELLA HIGH SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR

ADDITIONAL MATHEMATICS **4049/2**
Paper 2

26 August 2025

Candidates answer on the Question Paper. **2 hours 15 minutes**

READ THESE INSTRUCTIONS FIRST

Write your class, 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.

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.

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 Examiners' Use

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
/ 7	/ 7	/ 9	/ 7	/ 12	/ 9	/ 8	/ 11

Q9	Q10
/ 9	/ 11

SUBTOTAL		
Statement		
Presentation		
Units		
Rounding Off		90

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 **(a)** A polynomial $\mathrm{f}(x)$ has a remainder of -1 when divided by $2x + 3$.

(i) Find the remainder when $\mathrm{f}(x) - 1$ is divided by $2x + 3$. [1]

(ii) Find in terms of $\mathrm{f}(x)$, a polynomial which is divisible by $2x + 3$. [1]

(b) The cubic polynomial g(x) is such that the coefficient of x^3 is 2 and the roots of g(x) = 0 are -1, m and $2m$, where m is an integer. It is given that $g(x)$ has a remainder of 12 when divided by $x - 1$.

Find an expression for g(x) in descending powers of x. [5]

2 The equation of a curve is $y = \dfrac{\ln x}{x}$.

(a) Find the coordinates of the stationary point of this curve.
Leave your answer in terms of *e*. [4]

(b) Determine the nature of the stationary point. [3]

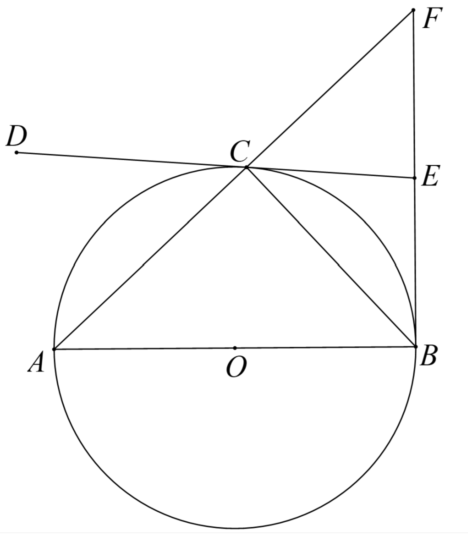
3 The decay of a certain radioactive isotope can be modelled by the exponential equation $N = N_0e^{-at}$ after t weeks, where N represents the amount of radioactive isotope, N_0 and a are constants.
A sample of this radioactive isotope has a mass of 100.9 g initially.
After 2 weeks, it is found that the amount of this sample left is 84.6 g.

(a) Calculate the value of a. [3]

(b) What percentage of this sample has decayed after 5 weeks? [3]

(c) Find the number of weeks when the amount of radioactive isotope decayed first exceeds 60 g. Give your answer correct to the nearest week. [3]

4 In the diagram, AB is the diameter of the circle with centre O.
DE and BF are tangents to the circle at C and B respectively.
DCE and BEF are straight lines.



(a) Prove that triangle ABC and triangle AFB are similar. [3]

(b) Show that $EC = EF$. [4]

5 **(a)** Find the integer a and b which satisfy the equation

$$\left(\frac{1}{8}y^{3}\right)^{-1} \div \left(4y^{2}\right)^{\frac{1}{2}} = 2^{a}\,y^{b}.$$ [3]

(b) Solve the equation $\log_{3}\left(x-8\right) = 2 - \dfrac{1}{\log_{x} 3}$. [5]

(c) Solve the equation $4^{x+1} + 7\left(2^{x}\right) = 2$. [4]

6 **(a)** Given that $y = 2\cos x \sin 2x - \sin x \cos 2x$, show that $\dfrac{\mathrm{d}y}{\mathrm{d}x} = k \cos x \cos 2x$, stating the value of k. [4]

(b) Hence, show that $\int_0^{\frac{\pi}{4}} \left(7\cos x \cos 2x + \sec^2 x\right) \mathrm{d}x = \frac{7\sqrt{2}}{3} + 1$. [5]

7 Two points $A(-3, -6)$ and $B(7, -6)$ lie on a circle with centre G. The equation of the tangent to the circle at the point $Q(1, -12)$ is $x + 5y + 59 = 0$.

(a) Show that the coordinates of G is $(2, -7)$. [5]

(b) Find the equation of the circle in the form of $x^2 + y^2 + 2gx + 2fy + c = 0$, stating the value of f, g and c. [3]

8 A particle P moves in a straight line and passes through a fixed point O so that its velocity, v m/s is given by $v = t^2 - 5t + 4$, where t is the time in seconds after passing O.

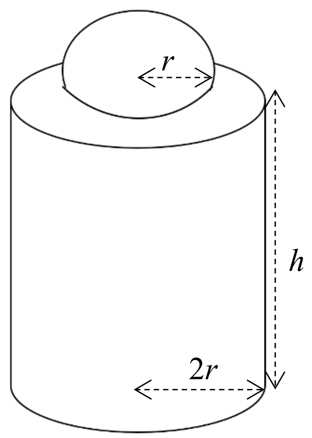
(a) Find the values of t when the particle is instantaneously at rest. [2]

(b) Find the values of t when the particle returns to O. [4]

(c) Find the acceleration of the particle when it first returns to O. [2]

(d) Find the average speed during the first 5 seconds. [3]

9 The diagram shows a paper weight which is made up of a solid hemisphere of radius r cm, resting on top of a solid cylinder of radius $2r$ cm and height h cm.

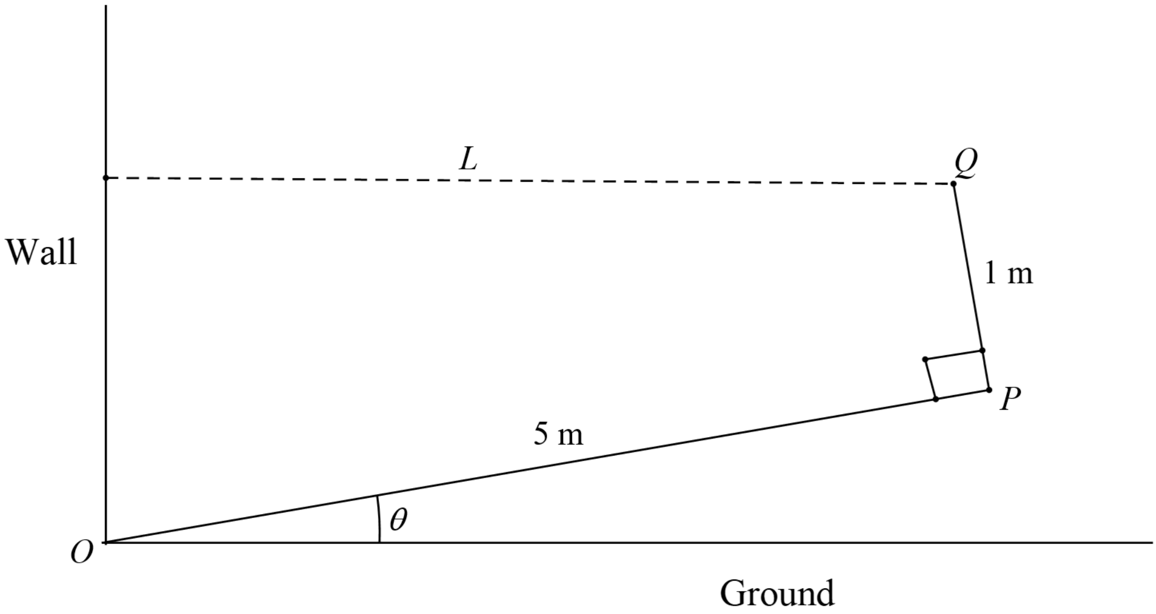


(a) Given that the total volume of the solid is 216π cm^3, express h in terms of r. [2]

(b) Show that the total surface area, A cm^2, of the solid is given by , $A = \dfrac{25\pi r^2}{3} + \dfrac{216\pi}{r}$. [2]

(c) Given that r can vary, find the value of r for which A has a stationary value. Find this value of A and determine whether it is a maximum or a minimum. [5]

10 A L-shaped structure, OPQ can be rotated about O. OP and PQ measures 5 m and 1 m respectively. OP makes an acute angle, θ, with the ground. The shortest distance from Q to the wall is is L m.



(a) Show that $L = 5\cos\theta - \sin\theta$. [2]

(b) Express L in the form $R\cos(\theta + \alpha)$, where $R > 0$ and $0° < \alpha < 90°$. [3]

(c) State the minimum value of L and the corresponding value of θ. [3]

(d) Find the value of θ when $L = 3$. [2]

(e) Explain why the maximum value of L is not R. [1]

End of Paper

Maris Stella High School
2025 Secondary 4 Additional Mathematics
Prelim Examination Paper 2 Answer Keys

Qn	Answer Key
1a)	i) -2 ii) $Polynomial = f(x)+1$
1b)	$2x^3 - 10x^2 + 4x + 16$
2a)	$\left(e, \frac{1}{e}\right)$
2b)	Maximum point
3a)	0.0881
3b)	35.6%
3c)	11
5a)	$a = 2$, $b = -4$
5b)	$x = 9$
5c)	$x = -2$
6a)	$k = 3$
7b)	$x^2 - 4x + y^2 + 14y + 27 = 0$ $g = -2, f = 7, c = 27$
8a)	$t = 1, 4$
8b)	$t = 2.31, 5.19$
8c)	-0.372 m/s^2
8d)	1.63m/s
9a)	$h = \frac{54}{r^2} - \frac{r}{6}$
9c)	$r = 2.35$, $A = 433$, maximum
10b)	$L = \sqrt{26}\cos\left(\theta + 11.3°\right)$
10c)	min $L = 0$ when $\theta = 78.7°$
10d)	42.7°