

Class	Register Number	Name
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南洋女子中學校
Nanyang Girls' High School

End-of-Year Examination 2025 Secondary 3

INTEGRATED MATHEMATICS 1

Tuesday 14 October

2 hours
0845 – 1045

READ THESE INSTRUCTIONS FIRST

1. Write your name, register number and class in the spaces at the top of this page.
2. Write in dark blue or black ink.
3. You may use a 2B pencil for any diagrams or graphs.
4. Do not use staples, paper clips, glue or correction tape/ fluid.
5. Write your answers and working in the space provided.
6. Answer **all** questions.
7. Omission of essential working will result in loss of marks.
8. The use of an approved scientific calculator is expected, where appropriate.
9. 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 degree to one decimal place. For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .
10. The number of marks is given in brackets [] at the end of each question or part question.

For examiners' use

Q1	
Q2	
Q3	
Q4	
Q5	
Q6	
Q7	
Q8	
Q9	
Q10	
Q11	
Total	/ 80

This document consists of **21** printed pages and **1** blank page.

NANYANG GIRLS' HIGH SCHOOL

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*Mathematical Formulae**Quadratic Equation*

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

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

Mensuration

$$\text{Area of triangle } ABC = \frac{1}{2} ab \sin C$$

Arc length $= r\theta$, where θ is in radians

Sector area $= \frac{1}{2} r^2 \theta$, where θ is in radians

Trigonometry

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

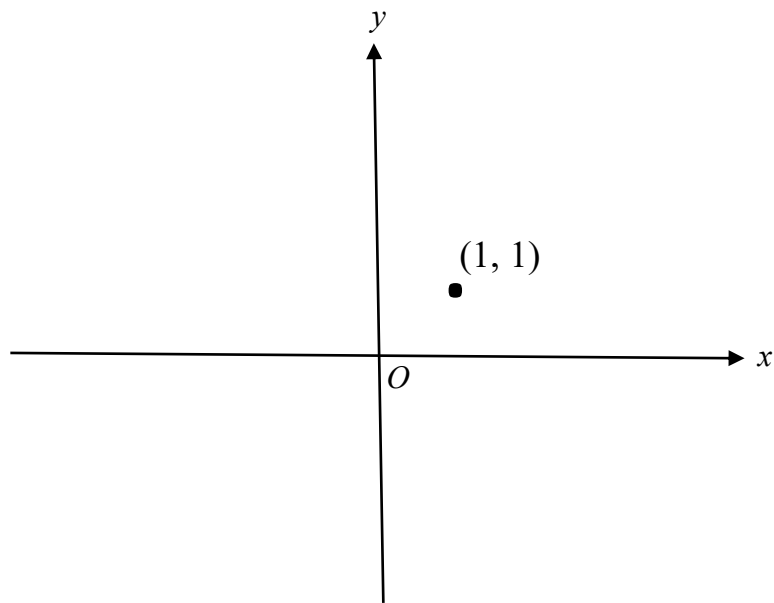
$$a^2 = b^2 + c^2 - 2bc \cos A$$

- 1** The axes below show a point with coordinates $(1, 1)$. Sketch, on the same axes, the graphs of

(a) $y = \frac{1}{x}$, [1]

(b) $y = x^3$, [1]

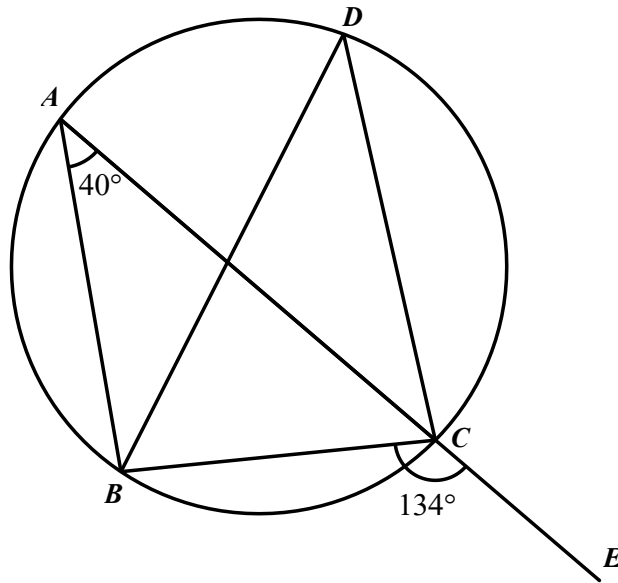
(c) $y^2 = x$. [1]



- 2** Variables x and y are related by the equation $y = ax^2 + bx$, where a and b are constants.

A straight line graph can be drawn to represent this equation. State which variables should be plotted on each axis and explain how the values of a and b can be calculated. [4]

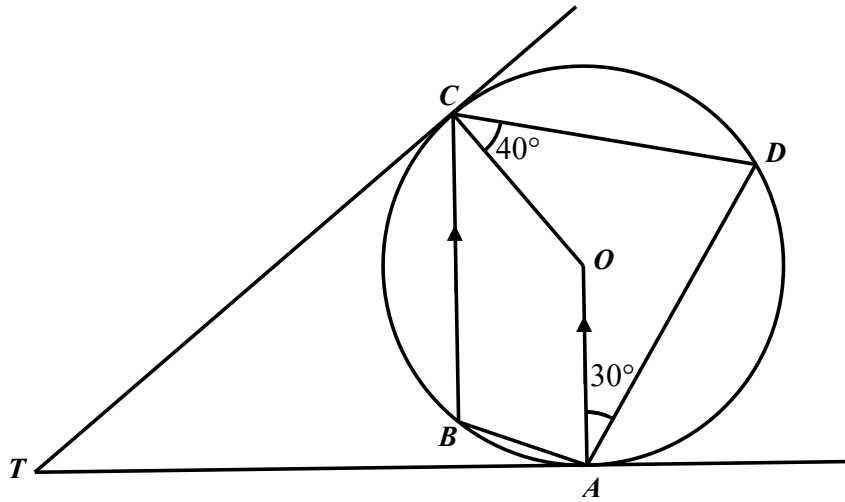
- 3 In the diagram, A , B , C and D are four points on a circle. ACE is a straight line. Angle $BAC = 40^\circ$ and angle $BCE = 134^\circ$.



- (a) Find angle BDC , giving a reason for your answer. [1]
- (b) Explain why AC is not a diameter of the circle. [2]

- 4 The variables x and y are such that when values of $\frac{1}{y}$ are plotted against $\frac{1}{\sqrt{x}}$, a straight line is obtained. Two points $\left(2, \frac{5}{2}\right)$ and $\left(6, \frac{9}{2}\right)$ lie on the straight line. Find an expression for y in terms of x . [4]

- 5 In the diagram, A , B , C and D are four points on a circle, centre O . AT and CT are tangents to the circle. AO and BC are parallel. Angle $OAD = 30^\circ$ and angle $OCD = 40^\circ$.



- (a) Find angle ADC .

[1]

- (b) Find, giving reasons for each answer,

- (i) angle CAT ,

[1]

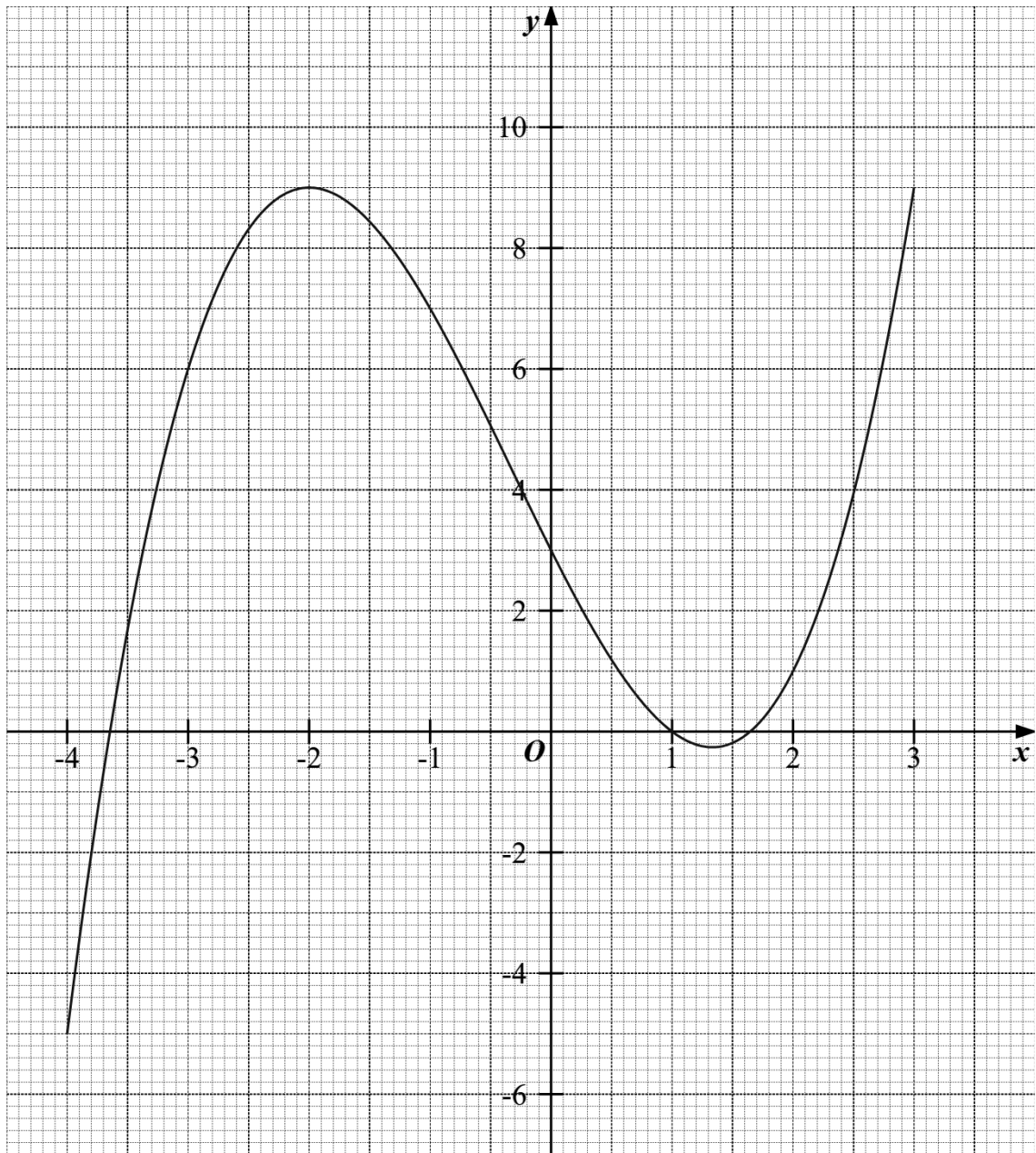
- (ii) obtuse angle AOC ,

[1]

5 (b) (iii) angle OAB , [2]

(iv) angle ATC . [2]

- 6 The graph of $y = \frac{1}{2}x^3 + \frac{1}{2}x^2 - 4x + 3$ is drawn on the grid.



- (a) By drawing a tangent, find the gradient of the curve at $(-3, 6)$.

[3]

- 6 (b) By drawing a suitable straight line on the graph, solve the equation

$$\frac{1}{2}x^3 + \frac{1}{2}x^2 - 5x = 0.$$

[3]

- (c) (i) Draw the line $y = 2x$ on the graph.

[1]

- (ii) The gradient of a point on the curve is 2. Its x -coordinate is p . Given that $p > 0$, find the value of p .

[2]

- (d) The equation $\frac{1}{2}x^3 + \frac{1}{2}x^2 - 4x + 5 = 0$ has only one solution. Explain how this can be seen from your graph.

[2]

7 A parallelogram $ABCD$ has vertices $A(-3, 0)$, $B(4, 3)$ and $C(7, 7)$.

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

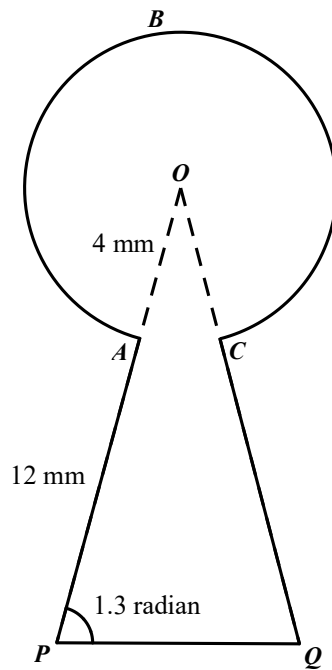
(b) Find the equation of AD . [2]

(c) Find the area of the parallelogram $ABCD$. [2]

7 (d) Point E divides BC internally in the ratio $3 : 2$. Find the coordinates of E . [2]

(e) Find the acute angle formed between the line AB and the x -axis. [2]

- 8 The diagram shows a keyhole $ABCQP$. ABC is part of a circle with centre O and radius 4 mm. Triangle POQ is isosceles with $AP = 12$ mm and angle $QPO = 1.3$ radians.



- (a) Find reflex angle AOC . [1]
- (b) Find the area of the major sector $OABC$. [2]

8 (c) Find the perimeter of the keyhole.

[3]

9 The equation of a circle, C , with centre A , is $x^2 + y^2 - 6x + 10y = 15$.

(a) Find the coordinates of A and the radius of C . [3]

(b) The straight line QR is parallel to the y -axis. Find the coordinates of two points, Q and R , on the circle which are the nearest and the farthest from the x -axis respectively. [2]

- 9 (c) Susan claims that the point $P(7, 1)$ lies on C .
Do you agree? Show your working clearly.

[2]

- (d) Point G is a movable point on the y -axis. Find the value of $\frac{\text{area of triangle } AGQ}{\text{area of triangle } RGQ}$.

[2]

- 10** The People Association of Singapore offers Health and Wellness courses at an affordable price in community clubs. Celine is a Pilates instructor who offers classes at Basic, Intermediate and Advanced levels on both weekdays and weekends. Each student who has signed up has a 10-week block of lessons with one lesson per week.

The matrix **P** shows the number of students Celine has each week in one 10-week block.

Basic	Intermediate	Advanced	
$\mathbf{P} = \begin{pmatrix} 28 & 35 & 12 \\ 32 & 40 & 17 \end{pmatrix}$			Weekdays
			Weekends

- (a)** Evaluate the matrix $\mathbf{Q} = 10\mathbf{P}$. [1]

- (b)** Celine charges \$8 for each basic lesson, \$12 for each intermediate lesson and \$20 for each Advanced lesson.

Represent the charges for the lessons in a 3×1 column matrix **R**. [1]

- (c)** Evaluate the matrix $\mathbf{M} = \mathbf{QR}$. [1]

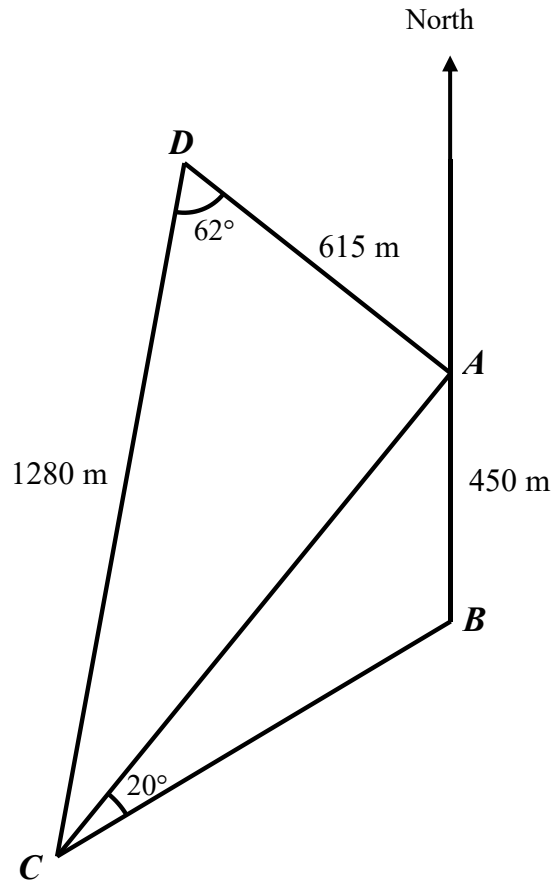
10 (d) State what the elements of **M** represent.

[2]

- (e) The community clubs charge the instructors for the use of venues and utilities. Celine is charged a total of \$580 on weekdays and \$700 at weekends for the 10-week block of lessons.
- She wishes to keep the total amount of money earned the same despite these charges. As such, how much should Celine charge for each Advanced lesson while keeping the charges for the Basic and Intermediate lessons unchanged? Leave your answer to the nearest whole number.

[4]

- 11** $ABCD$ is a park on horizontal ground crossed by a path AC .
 A is due north of B . $AB = 450$ m, $CD = 1280$ m and $AD = 615$ m. Angle $ADC = 62^\circ$,
angle $ACB = 20^\circ$ and angle ABC is obtuse.



- (a)** Calculate the area of triangle ACD , correct to 2 decimal places.

[2]

11 (b) Show that $AC = 1130$ m, correct to 4 significant figures. [2]

(c) Maryanne claims that the shortest distance from D to AC is 580 m.
Do you agree? Show your working clearly. [2]

11 (d) Calculate the bearing of B from C . [3]

(e) Maryanne goes for a jog in the park at a speed of 8 km/h. She starts at A and jogs towards C directly.

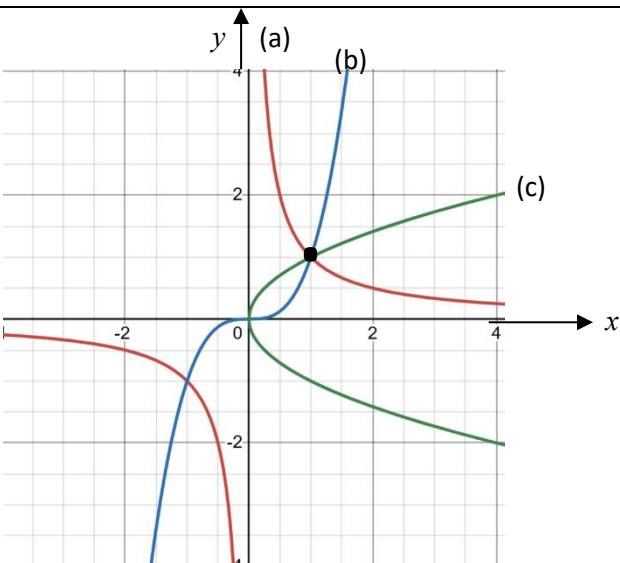
(i) Calculate the time it takes her to jog this route. Give your answer in minutes and seconds, correct to the nearest seconds. [2]

- 11 (e) (ii) During her jog, she spots an eagle on a lamp post at B . Calculate the distance she is from A such that the angle of elevation of the eagle from her is the greatest. [3]

End of Paper

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2025 Sec 3 IM1 EOY Answer Key

1	
2	$y = ax^2 + bx$ $\frac{y}{x} = ax + b$ Vertical axis is $\frac{y}{x}$. Horizontal axis is x. Gradient = a Vertical intercept = b Or $y = ax^2 + bx$ $\frac{y}{x^2} = a + \frac{b}{x}$ Vertical axis is $\frac{y}{x^2}$. Horizontal axis is $\frac{1}{x}$. Gradient = b Vertical intercept = a
3(a)	$\angle BDC = 40^\circ$ ($\angle$ s in the same segments)
(b)	$\angle ABC = 134^\circ - 40^\circ$ (ext $\angle$ of a Δ) $= 94^\circ$ Or

	$\angle ACB = 180^\circ - 134^\circ$ (adj $\angle$ s on a str line) $= 46^\circ$ $\angle ABC = 180^\circ - 46^\circ - 40^\circ$ ($\angle$ s sum of a $\triangle$) $= 94^\circ$ Since $\angle ABC \neq 90^\circ$, by the converse of right angle in semicircle , AC is not a diameter of the circle.
4	$y = \frac{2\sqrt{x}}{1+3\sqrt{x}}$
5(a)	$\angle ADC = 70^\circ$
(b)(i)	$\angle CAT = 70^\circ$ (Alternate Segment Thm)
(ii)	$\angle AOC = 140^\circ$ ($\angle$ at centre = $2\angle$ at circumference)
(iii)	$\angle OAB = 70^\circ$ (int $\angle$ s, $OA \parallel CB$)
(iv)	$\angle ATC = 40^\circ$
6(a)	Gradient = 6.5 ± 0.5
(b)	Draw $y = x + 3$ $x = -3.7 \pm 0.1$ or 0 or 2.7 ± 0.1
(c)(i)	Draw $y = 2x$
(ii)	$m = 1.7 \pm 0.1$
(d)	The line $y = -2$ cuts the curve at only one point.
7(a)	$D(0, 4)$
(b)	equation of AD is $y = \frac{4}{3}x + 4$
(c)	Area = 19 units^2
(d)	$E = (5.8, 5.4)$
(e)	$\theta = 23.2^\circ$ (to 1 dp)
8(a)	reflex $\angle POQ = \pi + 2.6$ or ≥ 3 sf from 5.74159
(b)	area of major sector = 45.9 mm^2

(c)	Perimeter = 55.5 mm
9(a)	$(x-3)^2 + (y+5)^2 = 49$ $A(3, -5)$ Radius of $C = 7$ units
(b)	$Q(3, 2)$ $R(3, -12)$
(c)	Sub $(7, 1)$ into $(x-3)^2 + (y+5)^2$, $(7-3)^2 + (1+5)^2$ $= 4^2 + 6^2$ $= 52$ $\neq 49$ $P(7, 1)$ does not lie on C . I disagree with Susan. Or $AP = \sqrt{52} \neq 7$
(d)	$\frac{1}{2}$
10(a)	$\mathbf{Q} = \begin{pmatrix} 280 & 350 & 120 \\ 320 & 400 & 170 \end{pmatrix}$
(b)	$\mathbf{R} = \begin{pmatrix} 8 \\ 12 \\ 20 \end{pmatrix}$
(c)	$\begin{pmatrix} 8840 \\ 9400 \end{pmatrix}$
(d)	The elements represent the total amount of money collected from all her students on weekdays and at weekends respectively , for an 10-week block of lessons.
(e)	Charge for each Adv class is \$24.
11(a)	347528.17 m ² (to 2 dp)
(b)	$AC = \sqrt{1280^2 + 615^2 - 2(1280)(615)\cos 62^\circ}$ ≈ 1130.3 (must write) $= 1130$ m (shown)
(c)	$\frac{1}{2} \times \perp \text{ height of triangle} \times 1130.3 = 347528.1725$ $\perp \text{ height of triangle} = 614.93$ m Since $580 \neq 614.93$, the shortest distance from D to AC is not 580 m
(d)	bearing of B from C is 059.2°

(ei)	8 min 29 sec
(eii)	Distance req = 349 m