



**BEATTY SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2024
SECONDARY FOUR NORMAL (ACADEMIC)**

CANDIDATE
NAME

CLASS

REGISTER
NUMBER

MATHEMATICS SYLLABUS A

Paper 2

4045/02

06 August 2024

2 hours

Candidates answer all questions on the Question Paper

Additional Materials: Nil

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number in the spaces on 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.

Section A

Answer **all** questions.

Section B

Answer **one** question.

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

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 total of the marks for this paper is 70.

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.

For π , use either your calculator value or 3.142.

For Examiner's Use

1	
2	
3	
4	
5	
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7	
8	
9	
10	
11 or 12 (Choose one)	
Total	/70

This document consists of **19** printed pages and **1** blank page.

[Turn over

Mathematical Formulae*Compound Interest*

$$\text{Total amount} = P \left(1 + \frac{r}{100} \right)^n$$

Mensuration

$$\text{Curved Surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3} \pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3} \pi r^3$$

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

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

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

Trigonometry

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

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

Statistics

$$\text{Mean} = \frac{\Sigma fx}{\Sigma f}$$

$$\text{Standard deviation} = \sqrt{\frac{\Sigma fx^2}{\Sigma f} - \left(\frac{\Sigma fx}{\Sigma f} \right)^2}$$

Section A (62 marks)

Answer **all** the questions in this section.

1 **(a)** Solve the equation $5^x = \frac{1}{5}$.

Answer $x = \dots\dots\dots$ [1]

(b) Simplify $\left(\frac{2}{x}\right)^2 \div x^5$. Leave your answer in positive index form.

Answer $\dots\dots\dots$ [2]

(c) Factorise $15a^2b^2 - 3ab^2$.

Answer $\dots\dots\dots$ [1]

(d) Expand and simplify $6 - 2(x - 5)$.

Answer $\dots\dots\dots$ [2]

[Turn over

- 2 (a) Calculate the length between $P(1, -3)$ and $Q(5, 12)$.

Answer [2]

- (b)(i) y is inversely proportional to $\sqrt{x}$.

When $x = 9$, $y = 5$.

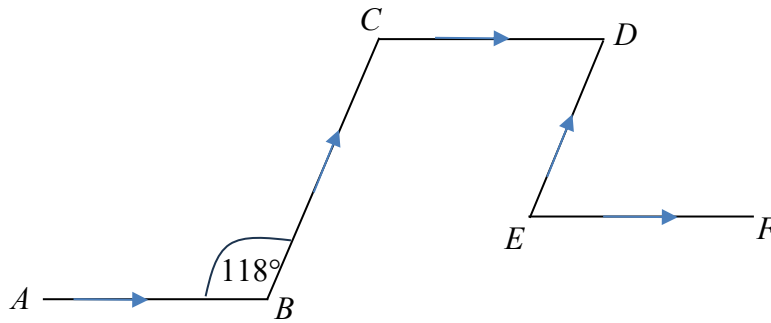
Find an equation connecting x and y .

Answer [2]

- (b)(ii) Find the value of y when $x = 25$.

Answer $y =$ [2]

- 3 (a) In the figure, AB , CD and EF are parallel, while BC and ED are parallel.



Find the Reflex Angle DEF .

Answer Reflex Angle $DEF = \dots\dots\dots$ [2]

- (b) Two interior angles of an octagon are $(2x-10)^\circ$ and $(3x+15)^\circ$.
The rest of the interior angles are equal to 135° each.
Find the value of x .

Answer $x = \dots\dots\dots$ [2]

[Turn over

4 A map is drawn to the scale of 1 : 20 000.

(a) The actual length of a road is 2.4 km.

Find the length of the road on the map. Give your answer in centimetres.

Answer cm [2]

(b) The area of a plantation on the map is 5.5 cm^2 .

Find the actual area of the plantation. Give your answer in km^2 .

Answer km^2 [2]

- 5 (a) By writing each value correct to 1 significant figure, estimate the value of

$$\frac{50.2 - 24.6}{\sqrt{96}}$$

Show your working.

Answer [2]

- (b) Solve $3x^2 + x - 2 = 0$.

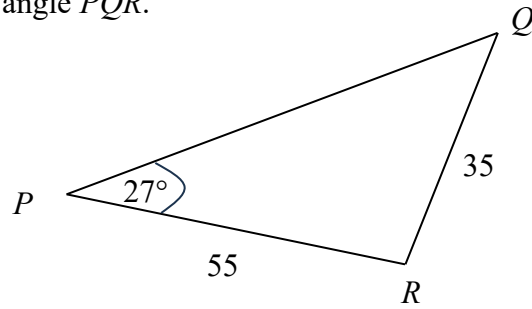
Answer $x =$ or [2]

- (c) Combine $\frac{9}{x^2 - 16} - \frac{2}{x - 4}$ into a single fraction.

Answer [3]

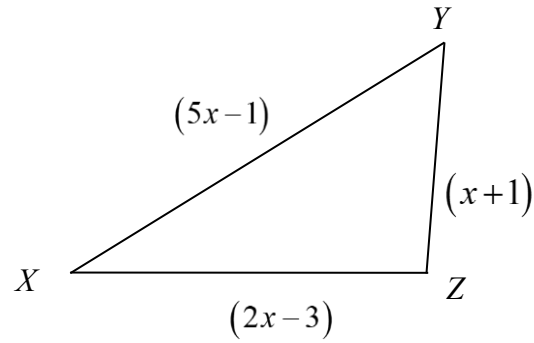
[Turn over

- 6 (a) P , Q and R are points on level ground. $QR = 35$ m, $PR = 55$ m and angle $QPR = 27^\circ$ m.
Calculate angle PQR .



Answer Angle $PQR = \dots\dots\dots$ [2]

- 6 (b) In triangle XYZ , $XY = (5x - 1)$ cm, $XZ = (2x - 3)$ cm and $YZ = (x + 1)$ cm.



Explain why the triangle above is not right angled. Show your working clearly.

Answer:

[3]

- 7 (a) Solve the simultaneous equations

$$\begin{aligned}2x - 3y &= 8 \\4x + 5y &= -6\end{aligned}$$

Answer $x = \dots\dots\dots, y = \dots\dots\dots$ [3]

- (b) There were a total of 51 red and blue balls in a box.
The ratio of red balls to blue balls was 6 : 11.
When some red balls were added into the box, the ratio of red balls to blue balls became 4 : 3.
How many red balls were added into the box?

Answer $\dots\dots\dots$ [3]

- 8 (a) The price of a painting increased by 200% from Year 2020 to Year 2024.
In Year 2024, the price of the painting was \$510 000.
Find the price of the painting in Year 2020.

Answer \$ [2]

- (b) The utilities bill for the Chan family in Jan 2024 was \$152 before 9% GST.
Calculate the utilities bill for the Chan family in Jan 2024 after 9% GST.

Answer \$ [2]

- (c) Bill deposits \$6400 into a bank account that pays compound interest of 4.3% per annum. Find the interest earned at the end of 10 years.

Answer \$ [2]

[Turn over

- 9 The variables x and y are connected by the equation $y = \frac{1}{x^2} + \frac{3x}{2} - 2$.

Some corresponding values of x and y are given in the table below.

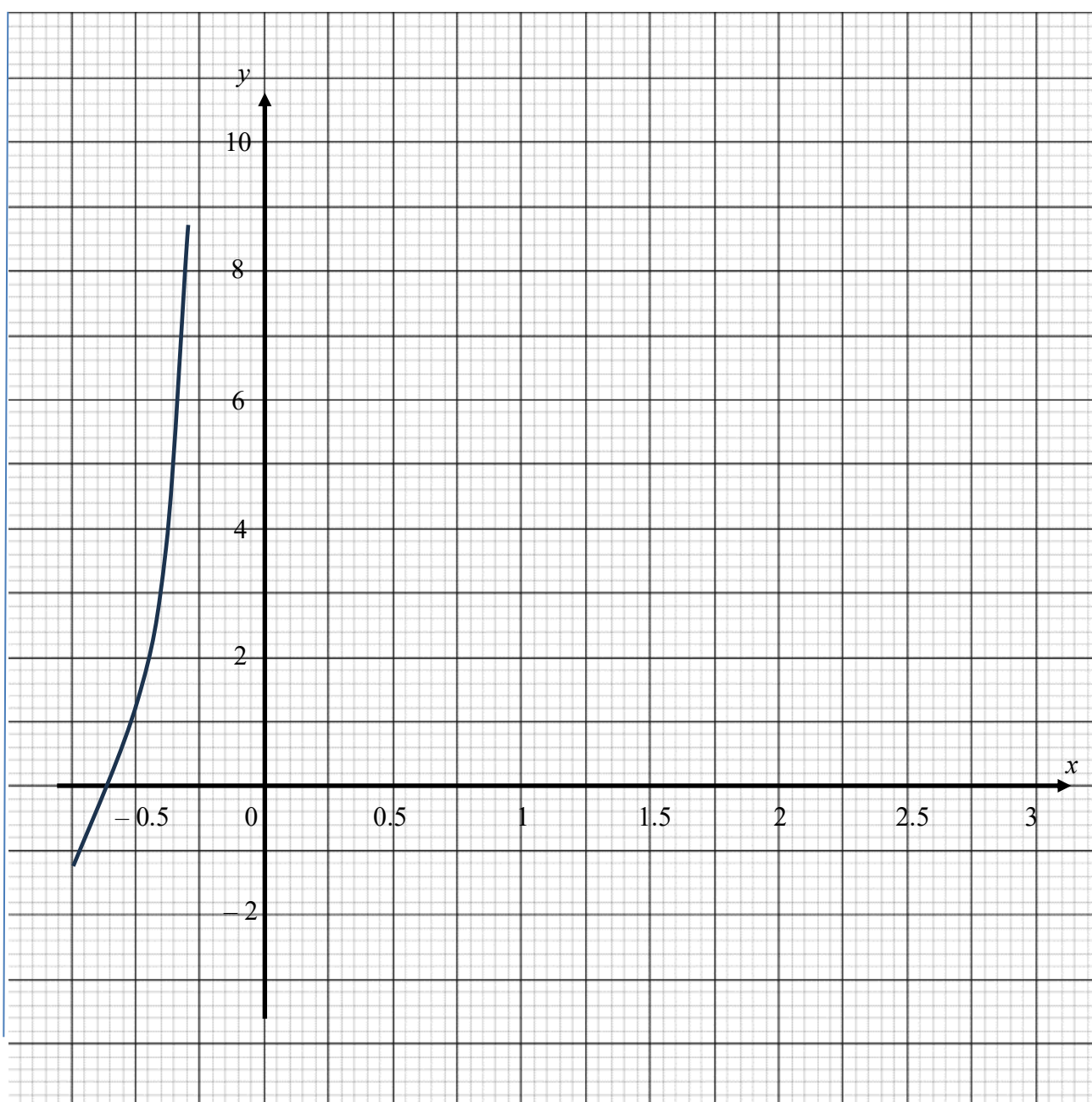
x	0.4	0.45	0.5	0.6	0.8	1	1.5	2	2.5	3
y	4.85		2.75	1.68	0.76	0.5	0.69	1.25	1.91	

(a) Complete the table.

[2]

(b) Draw the graph of $y = \frac{1}{x^2} + \frac{3x}{2} - 2$ for $0.4 \leq x \leq 3$.

The graph of $y = \frac{1}{x^2} + \frac{3x}{2} - 2$ for $-0.75 \leq x \leq -0.3$ has been drawn for you. [2]



(c) Explain why the graph does not exist when $x = 0$.

Answer:
 [1]

(d) By drawing a tangent, find the gradient of the curve at $x = 0.7$.

Answer [2]

(e) Use the graph to find the solutions to the equation $\frac{1}{x^2} + \frac{3x}{2} - 2 = 2$.

Answer $x =$ or or [2]

- 10 Singapore envisions to be a car-lite nation. The Land Transport Authority (LTA) manages road infrastructure efficiently and ownership of vehicles, among other strategies.

Table 1: Comparison of lengths of roads (in km) and land area of cities (in km²)

City	Length of Roads (km)	Land Area (km ²)	Road Density (km/km ²)
Singapore	9 500	729	
Kuala Lumpur	2 700	243	
Jakarta	7 200	662	
London	14 000	1572	
New York	12 900	778	

$$\text{Road density} = \frac{\text{length of road}}{\text{land area}}$$

- (a) Complete the table above. [2]
Then make a comparison of the road density in Singapore with the other cities.

Answer: [1]

Table 2: Number of car registrations per 10 000 people

Country	Population (millions)	Car registrations (per 10 000 people)
Singapore	5.64	1510
Malaysia	34	5210
Indonesia	276	800
United Kingdom	69	5620
United States	338	8390

- (b) Calculate the ratio
total car registrations in Singapore : total car registrations in United States,
and leave your answer in the form 1 : n , where n is a whole number.

Answer 1 : [3]

New car owners in Singapore must bid and register for a Certificate of Entitlement (COE) before they can purchase a car. In each month, there are two bidding rounds. Successful bidders pay the COE amount based on the category (CAT A or CAT B) depending on the new car they intend to buy, and proceed to register their cars.

The total number of new registrations each month vary but the ratio of CAT A to CAT B registrations is about 4 : 3 each month.

Table 3: COE registrations in Singapore in the first 6 months of 2024

Month	Bidding Round	CAT A (car up to 1600 cc & up to 110kw)	CAT B (car above 1600 cc or above 110kw)	Total New registrations
June	Second	\$90 889	\$102 334	2 551
June	First	\$88 200	\$100 607	2 571
May	Second	\$92 700	\$105 689	2 552
May	First	\$93 604	\$105 002	2 545
April	Second	\$94 010	\$102 001	2 498
April	First	\$89 000	\$101 334	2 509
March	Second	\$85 489	\$96 011	2 472
March	First	\$83 000	\$96 010	2 550
February	Second	\$76 801	\$97 000	2 491
February	First	\$79 000	\$102 338	2 482
January	Second	\$81 589	\$112 000	2 431
January	First	\$65 010	\$85 010	2 422

(c) Calculate the total amount of COE paid in April 2024.

Express your final answer in million dollars, and round it to 2 significant figures.

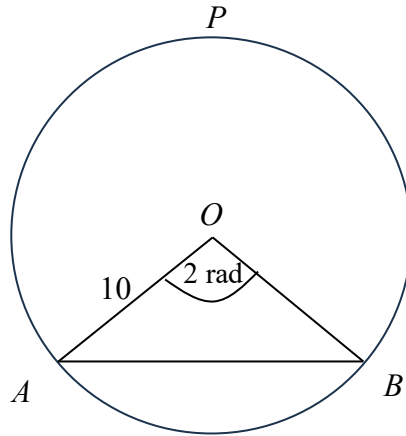
Answer \$ million [3]

[Turn over

Section B (8 marks)

Answer **one** question from this section. Each question carries 8 marks.

- 11** (a) A , B and P are points on a circle with centre at O , and radius of length 10 cm.
Angle $AOB = 2$ radians.



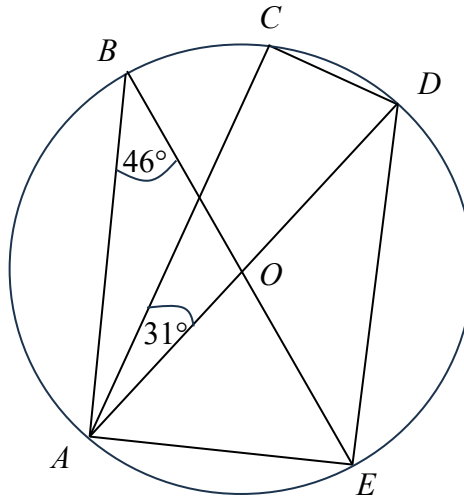
- (i) Calculate the length of AB .

Answer $AB = \dots\dots\dots$ cm [2]

- (ii) Calculate the area of the major segment APB .

Answer $\dots\dots\dots$ cm² [3]

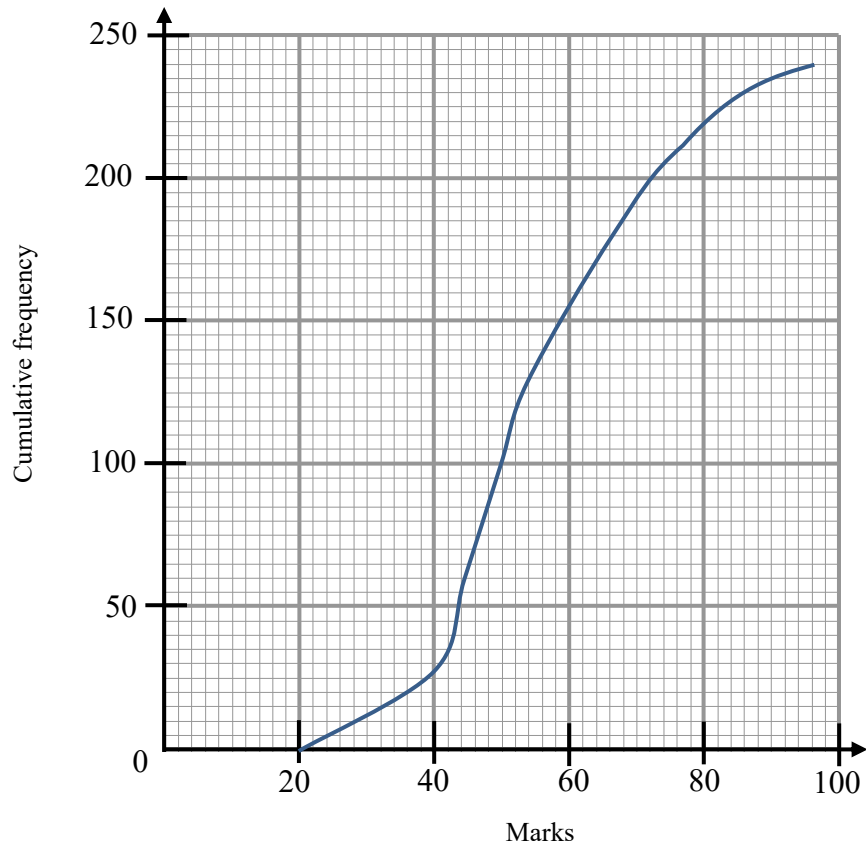
- (b) A, B, C, D and E are points on a circle, centre O .
 Angle $ABE = 46^\circ$ and angle $CAD = 31^\circ$.



Find Angle CDE .

Answer Angle CDE [3]

- 12 The cumulative frequency curve shows the marks scored by 240 students of School X for the Math Prelim Exams.



- (a) The passing mark is 50 marks. Students who do not pass have to go for LSP.
Find the number of students who have to go for LSP.

Answer [1]

- (b) Find the median and interquartile range.

Answer median = [1]

IQR = [1]

- (c) The median and inter-quartile range for students of School Y are 56 and 20 respectively.

Claim 1: Students of School Y performed better than students of School X.

Answer:

I agree/disagree because.....

.....

..... [1]

Claim 2: Students of School Y performed more consistently than students of School X.

Answer:

I agree/disagree because

.....

..... [1]

- (d) In a class, there are 13 boys and 16 girls.

A teacher randomly selects three students to represent the class for a competition.

Find the probability that only one student is a boy.

Answer [3]

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Answer Key

1(a) $x = -1$

1(b) $\frac{4}{x^7}$

1(c) $3ab^2(5a-1)$

1(d) $16-2x$

2(a) 15.5

2(b)(i) $y = \frac{15}{\sqrt{x}}$

2(b)(ii) $y = 3$

3(a) 298°

3(b) $x = 53$

4(a) 12 cm

4(b) 0.22 km^2

5(a) 3

5(b) $x = 2/3$ or -1

5(c) $\frac{1-2x}{(x+4)(x-4)}$

6(a) 45.5°

6(b) Since $(x+1)^2 + (2x-3)^2 \neq (5x-1)^2$, triangle XYZ is not right-angled. (with workings)

7(a) $x = 1$, $y = -2$

7(b) 26

8(a) \$170 000

8(b) \$165.68

8(c) \$3350.41

9(a) 3.61, 2.61

9(c) $\frac{1}{x^2}$ is not defined when $x = 0$

9(d) -3.9 to -4.6

9(e) $x = -0.45$, 0.55 , 2.55

10(a) 13.0, 11.1, 10.9, 8.91, 16.6, Singapore has a high road density compared to other cities in the table.

10(b) 1: 333

10(c) \$480 million dollars

11(a)(i) 16.8 cm

11(a)(ii) 260 cm^2

11(b) 105°

12(a) 100

12(b) Median = 52, IQR = $66 - 44 = 22$

12(c) Claim 1: I agree because Median (Y) > Median (X), so on average, students of School Y scored higher in the Math Prelim Exams.

Claim 2: I agree because IQR(Y) < IQR (X), so the marks of students of School Y were more consistent.

12(d) $\frac{260}{609}$

