XINMIN SECONDARY SCHOOL
新民中学
SEKOLAH MENENGAH XINMIN
Preliminary Examination 2024

CANDIDATE NAME			
CLASS		INDEX NUMBER	

MATHEMATICS 4052/02

Paper 2

22 August 2024

2 hours 15 minutes

Setter: Mr Johnson Chua
Vetter: Ms Vanessa Chia
Moderator: Mr Johnson Chua

Candidates answer on the Question Paper

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class 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.
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 in the space below the question.
Omission of essential working will result in loss of marks.
The total of the marks for this paper is 90.

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.

Errors	Qn No.	Errors	Qn No.
Accuracy		Simplification	
Brackets		Units	
Geometry		***Marks Awarded***	
Presentation		***Marks Penalised***	

Parent's/Guardian's Signature:

For Examiner's Use
90

Mathematical Formulae

Compound Interest

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

Mensuration

$$\text{Curved surface area of a cone} = \pi rl$$

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

1 **(a)** Solve $\frac{2x+7}{2} - \frac{7-x}{5} = 0$.

Answer x = …… [2]

(b) Solve the equation $(2x-3)(x-4) = 2$.

Answer x = ……... [4]

(c) Simplify $\frac{15x^2}{2y} \div \frac{3x^2y}{8}$, leaving your answer in positive index form.

Answer …….. [1]

(d) Simplify $\frac{ax + 3bx - 2a - 6b}{a^2 + ab - 6b^2}$.

Answer ……. [3]

2 **(a)** Account *A* pays 3% per year compound interest, compounded monthly.
Account *B* pays 3% per year compound interest, compounded yearly.

Cody has some money to invest for 5 years.

Explain which account Cody should invest his money in.

…….

…….

……. [1]

(b) Ezra invests \$20 000 in an account that pays x% per year compound interest.
He leaves the money in the account for 3 years.
At the end of 3 years, there is \$22 823.32 in the account.

Find the value of x, leaving your answer in one decimal place.

Answer x =…… [3]

(c) The cash price of a new car is $156 000.

(i) Cillian buys the car on hire purchase.
He pays a deposit of 40% in cash.
He then makes 36 monthly payments of $2800.

What is the total amount that Cillian pays for the car?

Answer $…….. [2]

(ii) The original value of the car is its cash price of $156 000.
Each year, the value of the car decreases by 8% of its value at the start of the year. At the end of 3 years, Cillian decides to sell the car.

Calculate the percentage loss Cillian will make, compared to the total amount he pays for the car.

Answer……% [3]

(d) The exchange rate between US dollars (US$) and Singapore dollars (S$) is US$1 = S$1.35.
The exchange rate between Singapore dollars (S$) and Canadian dollars (CA$) is S$1 = CA$1.02

Jude is planning a trip to America and Canada.
He finds the following hotel prices on a website.

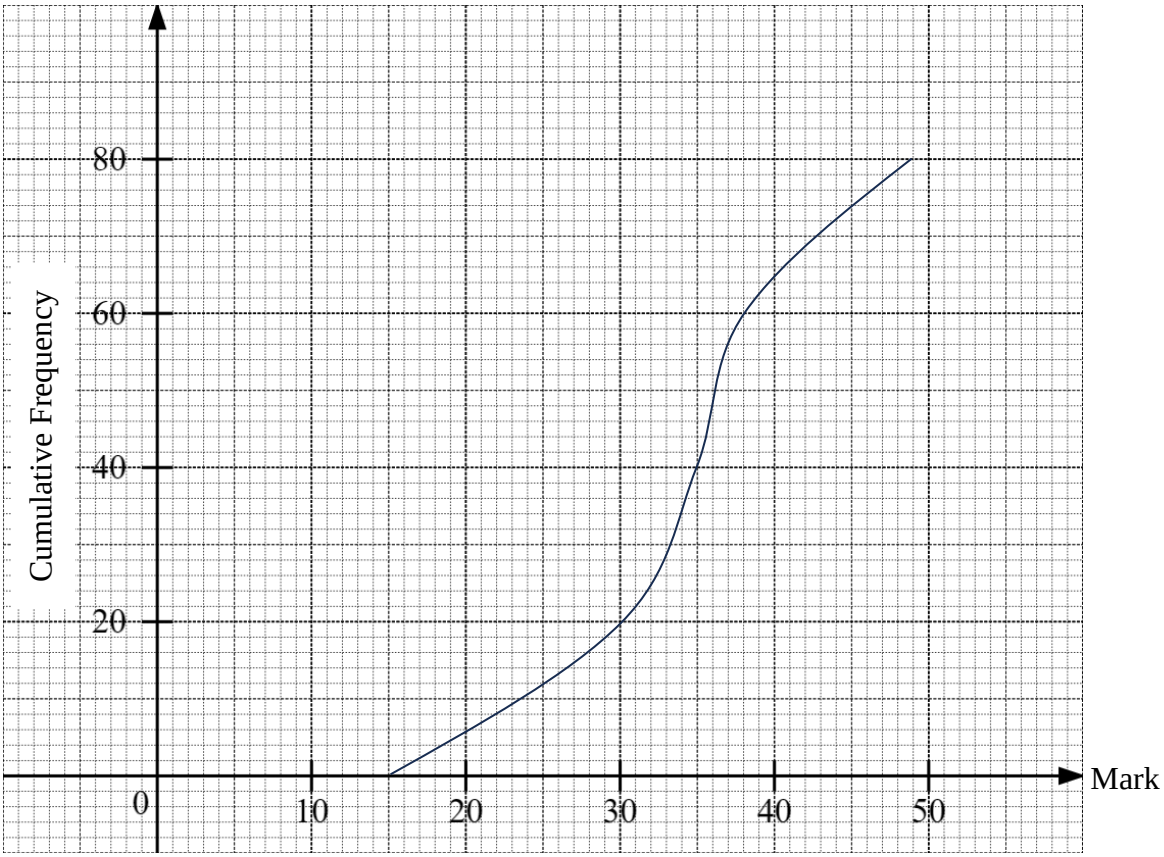
The Grand New York, US$368 per night
The Ontario Inn, CA$250 per night.

Jude books 2 nights at The Grand New York and 3 nights at The Ontario Inn using his credit card.
The credit card company converts the prices to Singapore dollars and Jude is charged a fee of 1.5% for the currency conversion.

Calculate the total amount Jude pays for both hotels, including the credit card fee.

Answer S$……. [3]

3 A group of 80 students took a Physics test.
The cumulative frequency curve below shows the distribution of their marks.



(a) Use the curve to estimate

(i) the median mark,

Answer ..... [1]

(ii) the interquartile range,

Answer ..... [2]

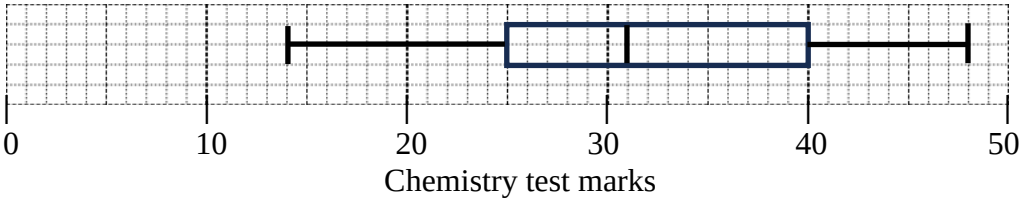
(iii) the 60th percentile.

Answer ..... [1]

(b) The passing mark for the test was x marks.
85% of the students passed the test.
Find the value of x.

Answer x = …… [2]

(c) The same group of students took a Chemistry test.
The box-and-whisker plot shows the distribution of their marks.



(i) Make two comparisons between the performances of the students in the two tests.

1. ……

……

……

2. ……

……

…… [2]

(ii) There was an error in a question from the Chemistry test.
Every student is awarded an additional mark as a result of the errata.

Describe the effect this change would have on the box-and-whisker plot.

……

…… [1]

4 **(a)** $\xi = \{\text{integers } x\text{: } 2 \leq x < 16\}$

$A = \{\text{multiples of 4}\}$

$B = \{\text{factors of 48}\}$

(i) List the elements in B'.

Answer ..... [1]

(ii) List the elements in $A' \cap B$.

Answer ..... [1]

(iii) A number, p, is chosen at random from the set $A \cup B$.
Find the probability that $p \notin B$.

Answer ..... [1]

4 (b) (i) A class has 40 students.

One of the students from the class is selected at random.
The probability that it is a student who does not study Physics is $\frac{1}{2}$.

Two of the students are selected at random.
The probability that they study both Literature and Physics is $\frac{1}{10}$.

Complete the table of information about the class of 40 students.
Please show relevant working in the space provided below the table.

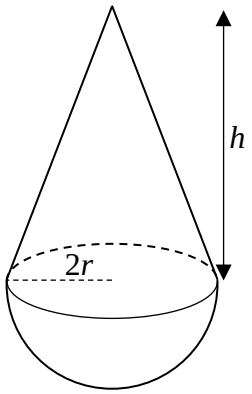
	Physics	Not Physics
Literature		
Not Literature		15

[4]

(ii) Two students are selected at random.
Find the probability that one of them study Literature while the other does not.

Answer ……. [2]

5 The diagram shows a solid made up of a right circular cone and a hemisphere.
The cone has a height of h cm.
Both cone and the hemisphere share the same radius of $2r$ cm.



(a) The volume of the cone equals to the volume of the hemisphere.
Show that $h = 4r$.

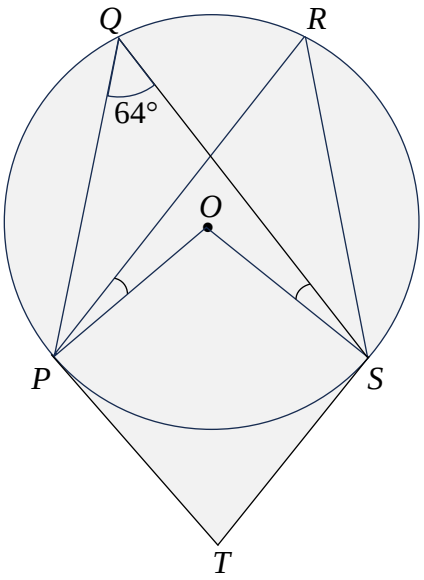
Answer

[3]

(b) The volume of the hemisphere is 450 cm^3.
Find the total surface area of the solid.

Answer ……cm^2 [5]

6



The diagram shows a circle with centre O.
P, Q, R and S are points on the circumference of the circle.
PT and ST are tangents to the circle.
Angle $PQS = 64°$ and angle $RPO =$ angle QSO.

(a) Prove that triangle SQP and triangle PRS are congruent.

Answer

[3]

(b) Explain why it is not possible to draw a circle passing through P, R, S and T.

……

…… [2]

(c) **(i)** Given that $PS = 13.5$ cm, show that the radius of the circle is 7.51 cm, correct to 3 significant figures.

Answer

[2]

(ii) Hence, find the area of the shaded figure.

Answer ……cm^2 [4]

7 **(a)** The points *A*, *B* and *C* are vertices of a triangle.

The point *A* is $(-5, 4)$.

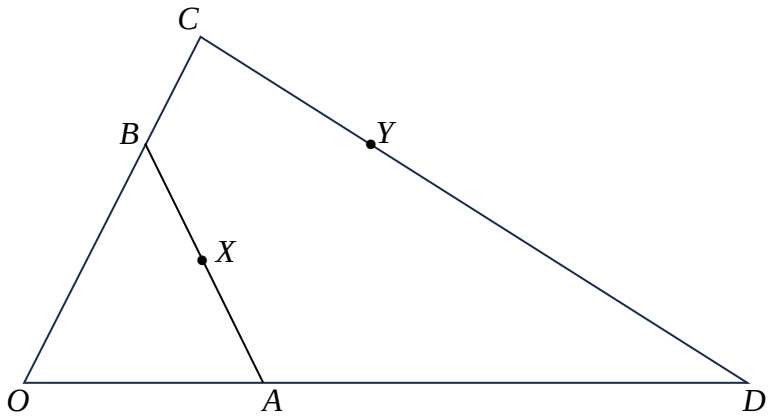
$\overrightarrow{AB} = \begin{pmatrix} 3k \\ 4k \end{pmatrix}$, where *k* is a positive constant.

Equation of *BC* is $x = 1$, and *C* lies on the *x*-axis.

Find the area of triangle *ABC*.

Answer ……units^2 [4]

7 (b)



In the diagram, $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

$\overrightarrow{OA} = \frac{1}{3}\overrightarrow{OD}$, $OB : BC = 2 : 1$ and X is the midpoint of AB.

Y is a point on CD such that $\overrightarrow{YD} = 2\mathbf{a} - \mathbf{b}$.

(i) Express, as simply as possible, in terms of **a** and **b**,

(a) $\overrightarrow{OX}$,

Answer $\overrightarrow{OX}$ = ……... [2]

(b) $\overrightarrow{OY}$.

Answer $\overrightarrow{OY}$ = …… [2]

(ii) Write down two facts about *O*, *X* and *Y*.

1. ……

……

2. ……

…… [2]

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8 **(a)** Complete the table of values for $y = \frac{2}{x^2} + \frac{x^2}{2} - 1$.

Values are given to one decimal place where appropriate.

x	–3	–2	–1.5	–1	–0.5	0.5	1	1.5	2	3
y	3.7	1.5	1.0		7.1	7.1		1.0	1.5	3.7

[1]

(b) On the grid opposite, draw the graph of $y = \frac{2}{x^2} + \frac{x^2}{2} - 1$ for $-3 \leq x \leq 3$. [3]

(c) By drawing a tangent, find the gradient of the curve at the point $(2,1.5)$.

Answer ..... [2]

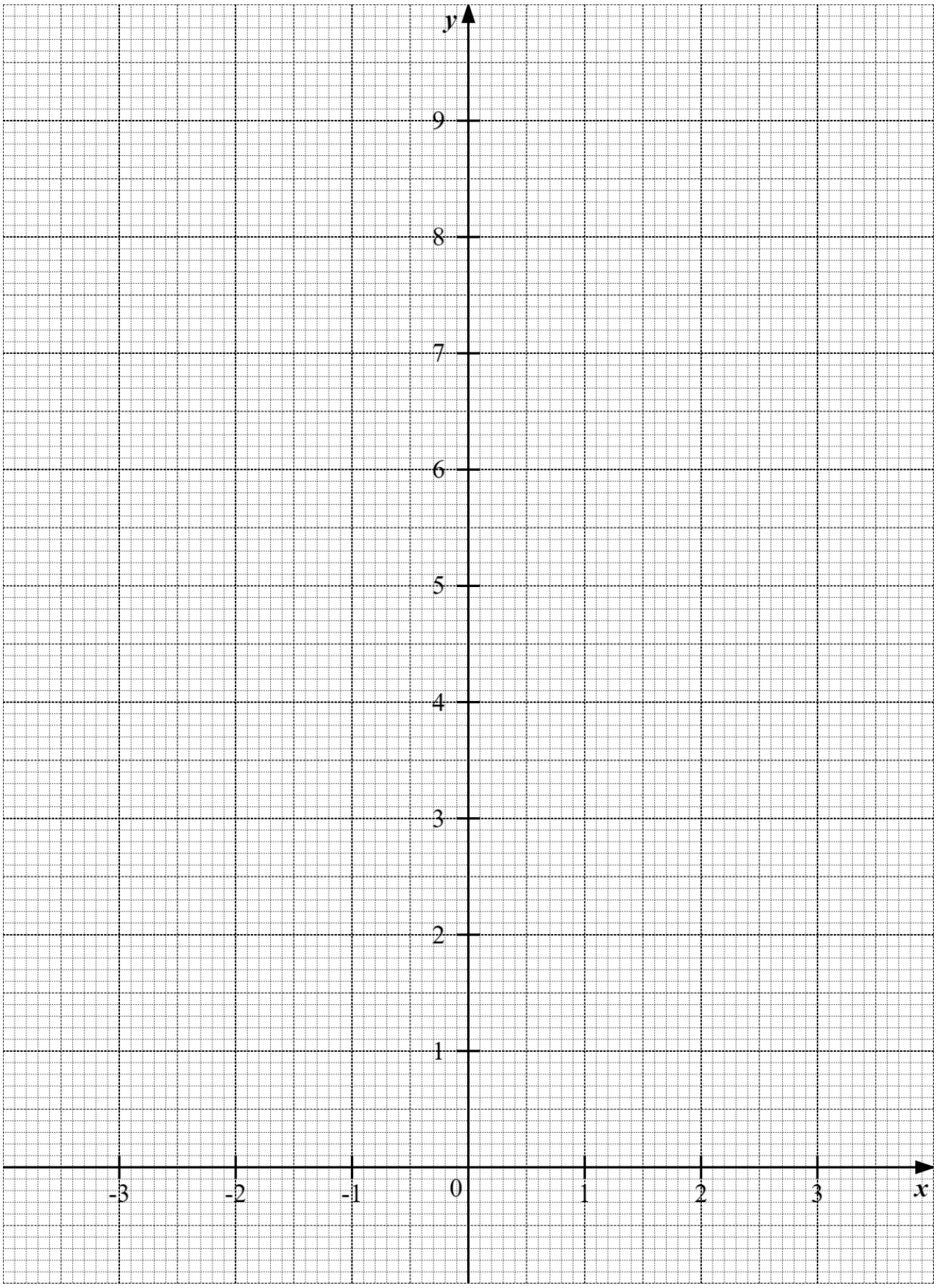
(d) The equation $\frac{2}{x^2} + \frac{x^2}{2} - 1 = k$ has two solutions.

Use your graph to estimate the value of k.

Answer k = ... [1]

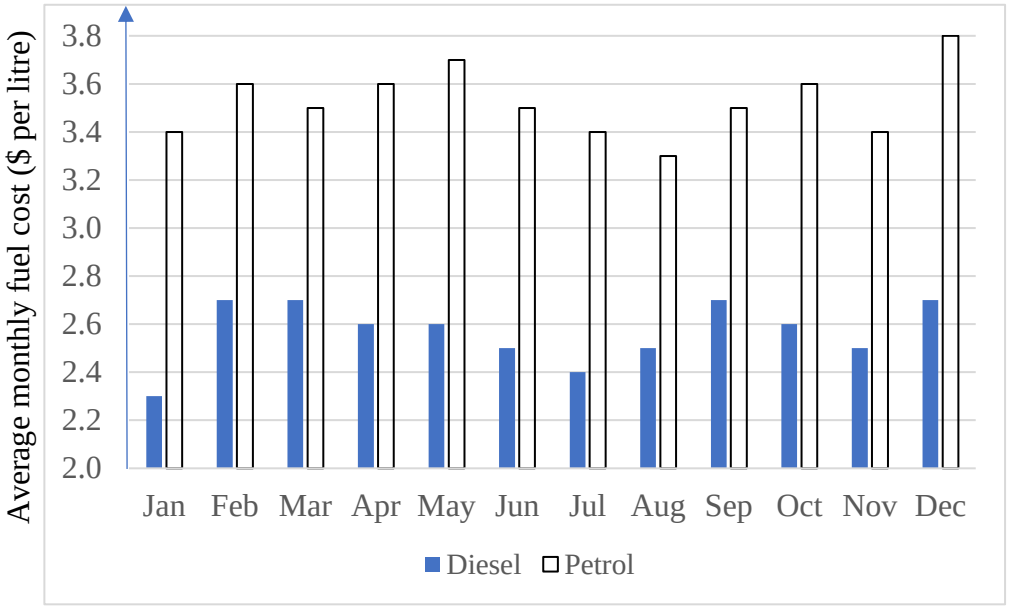
(e) By drawing a suitable straight line on the grid, solve the equation $x^4 + x^3 - 4x^2 + 4 = 0$.

Answer x = ... [4]


y
9
8
7
6
5
4
3
2
1
-3
-2
-1
0
1
2
3
x

9 Ean, who lives with 5 other adult members in his family, plans to purchase a car which could accommodate the whole family.
He did some research and found the following information:

1. Fuel cost for vehicles in Singapore, 2023



2. Road Tax Structure in Singapore

Engine capacity (y) in cc	Annual road tax formula ($)
$y \leq 600$	200×1.564
$600 < y \leq 1000$	$[200 + 0.125 \times (y - 600)] \times 1.564$
$1000 < y \leq 1600$	$[250 + 0.375 \times (y - 1000)] \times 1.564$
$1600 < y \leq 3000$	$[475 + 0.75 \times (y - 1600)] \times 1.564$
$y > 3000$	$[1525 + 1 \times (y - 3000)] \times 1.564$

(a) The engine capacity of a sedan car is 1400 cc.
Calculate the annual road tax which the owner of the sedan car needs to pay.

Answer $ …….. [1]

(b) Estimate the mean monthly cost of diesel over the 12-month period in 2023.

Answer $ …….. [2]

(c) Ean visited a car dealer who shortlisted three models for him:

Vehicle Model	**Toyoyo Joah**	**Ponda Jezel**	**Ponda Fleet**
Engine Capacity (in cc)	2000	1500	1500
Vehicle Type	Diesel Car	Hybrid	Hybrid
Fuel Type	Diesel	Petrol	Petrol
Fuel Consumption Rate	16 km per litre	25 km per litre	25 km per litre
Seating Capacity	7	5	7
Price	$160 000	$140 000	$172 000

In partnership with a finance company, the car dealer is offering Ean a loan package which he plans to take up:

Downpayment for car	$0
Simple Interest rate	4% per annum
Loan period	7 years

Ean estimates that he would drive about 11 000 km per year.
He also plans to keep the car for only 7 years.

Suggest the vehicle model he should purchase.
Justify your decision and show your calculations clearly.

Answer

(You may continue your answer to Question 9(c) here)

……...

……...

……..[7]

--- End of Paper---