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

CANDIDATE NAME

CLASS

INDEX NUMBER

MATHEMATICS

4052/01

Paper 1

21 August 2024

2 hour 15 minutes

Setter: Ms Low Yan Jin
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	

For Examiner's Use

90

Parent's/Guardian's Signature:

This document consists of **20** printed pages.

[Turn over

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Mathematical Formulae

Compound Interest

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

Mensuration

Curved surface area of a cone = πrl

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

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

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

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

Arc length $= r\theta$, where θ 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

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

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

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Answer **all** the questions.

1 Evaluate

(a) $\dfrac{8.75}{\sqrt{4.86}+0.982}$, correct to 2 decimal places,

Answer ..... [1]

(b) $\left(5.87\times10^{6}\right)\div\left(3.94\times10^{-2}\right)$, leaving your answer in standard form, correct to 3 significant figures.

Answer ..... [1]

---

2 **(a)** Express 540 as a product of its prime factors.

Answer ..... [1]

(b) The number $\dfrac{540x}{y}$ is a perfect square, where x and y are prime numbers and $x > y$. Find the value of x and of y.

Answer x = ...

y = ... [1]

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3 **(a)** Simplify $24a^2b^5 \div 8a^6b^{-2}$. Leave your answer in positive index form.

Answer ..... [1]

(b) Given that $9^k \times \frac{1}{729} = 3^k$, find the value of k.

Answer k = ... [2]

---

4 During a school's anniversary, Joey sold x cookies at 50 cents each and $(x + 30)$ chocolates at 90 cents each. Form an inequality in x and solve it to find the minimum value of x in order for her to receive at least \$152 from the sales.

Answer x = ... [3]

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5 Solve the simultaneous equations.

$$x + 3y = 29$$
$$2x = 5y - 30$$

Answer $x =$ .....

$y =$ ..... [3]

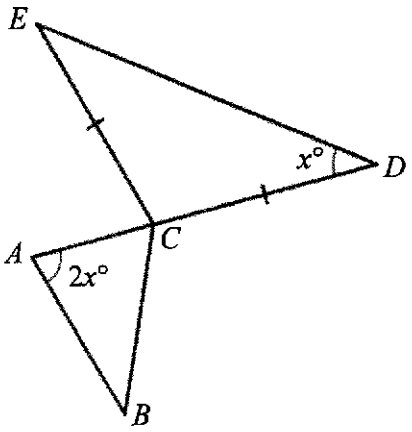
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6 Rearrange the formula $10 + y = \dfrac{x^2 + k}{x^2}$ to make x the subject.

Answer ..... [3]

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7 In the figure, ACD is a straight line and $CD = CE$.
Angle $CDE = x°$ and angle $CAB = 2x°$.
Determine if AB is parallel to CE, stating your reasons clearly.



Answer

.....

..... [2]

---

8 Simplify.

(a) $5(3x-2y)-2(x+4y)$

Answer ..... [2]

(b) $12p^2+8-(3p-2)^2$

Answer ..... [2]

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9 A map of Mount Fuji has a scale of 1 : 25 000.

(a) The length of a trail on the map is 52.2 cm.
Calculate the actual length, in kilometres, of the trail.

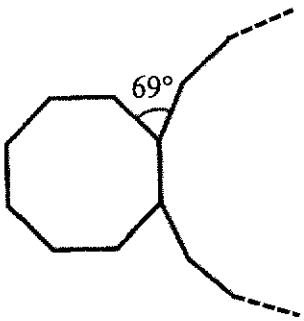
Answer ..... km [2]

(b) A lake at the base of Mount Fuji has an actual area of 6.57 km^2.
Calculate the area, in square centimetres, of the lake on the map.

Answer ..... cm^2 [2]

---

10 The diagram shows a regular octagon (8-sided) and part of an n-sided regular polygon.



Find the value of n.

Answer n = ... [4]

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11 The force, F Newtons, between two particles is inversely proportional to the square of the distance, d cm, between them.
If the force is 5.5 Newtons when the distance between the two particles is 2 cm, find

(a) an equation connecting F and d,

Answer ..... [2]

(b) the distance between two particles when the force is 3 Newtons.

Answer ..... cm [1]

---

12 **(a)** Factorise $6x^3 + 11x^2 - 7x$.

Answer ..... [2]

(b) Write as a single fraction in its simplest form $\frac{2x}{4x^2 - 25} + \frac{3}{2x - 5}$.

Answer ..... [3]

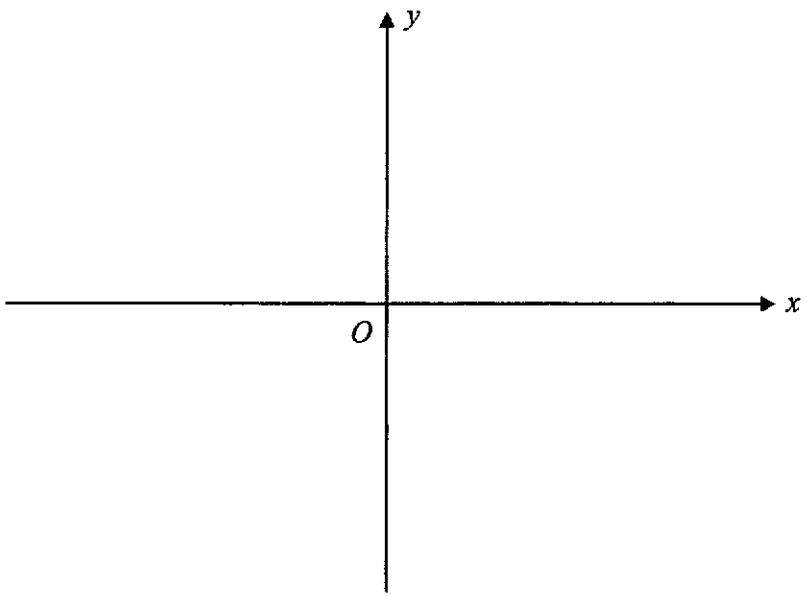
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13 **(a)** Express x^2-6x-7 in the form $(x-p)^2-q$.

Answer ..... [1]

(b) Hence, or otherwise, sketch the graph of $y=x^2-6x-7$ in the axes below. Indicate clearly the values where the graph crosses the axes and the coordinates of the turning point on the curve.

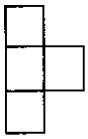
Answer



[3]

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14 An F-1 block is made up of 4 squares of sides 2 cm each.
The F-1 blocks can be combined to form more blocks and F-2 and F-3 blocks are shown below.



F-1



F-2



F-3

(a) Complete the table.

Block	F-1	F-2	F-3	F-4
Perimeter (cm)	20	28		

[1]

(b) Write down an expression, in terms of n, for the perimeter of an F-n block.

Answer ..... cm [1]

(c) Hence, explain if it is possible to have a block with a perimeter of 100 cm.

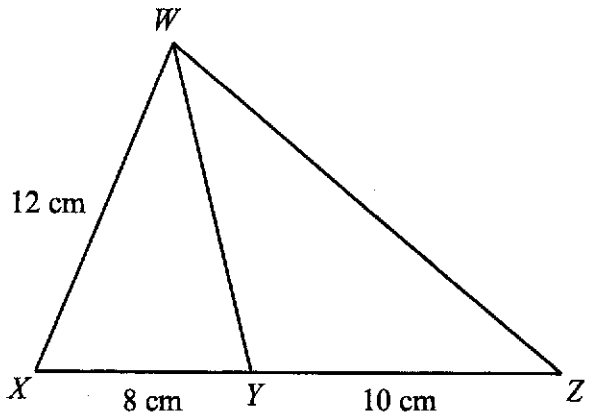
Answer

.....

..... [2]

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15 In the diagram, WXZ is a triangle. $WX = 12$ cm, $XY = 8$ cm and $YZ = 10$ cm.



(a) Show that triangles WXY and ZXW are similar.

Answer

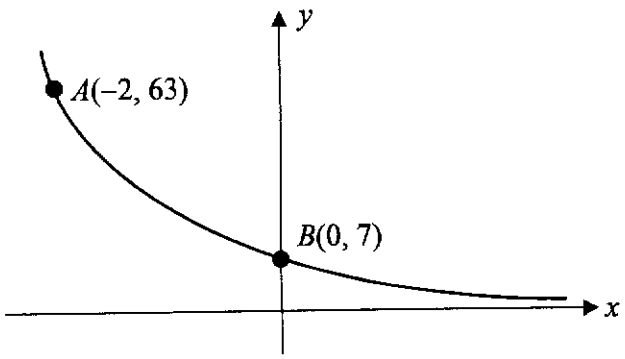
[2]

(b) If the area of triangle ZXW is x cm^2, find the area of triangle WYZ in terms of x.

Answer ..... cm^2 [2]

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16 The sketch shows the graph of $y = ka^{-x}$. The points $A(-2, 63)$ and $B(0, 7)$ lie on the graph.



(a) Find the values of k and of a.

Answer k = ...

a = ... [3]

(b) Find the equation of the line AB.

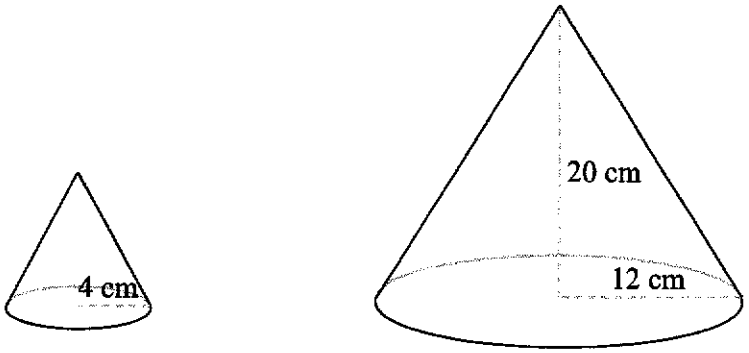
Answer ..... [2]

(c) Write down a possible equation of a line that does not intersect the line AB.

Answer ..... [1]

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17 Cone A has a radius of 4 cm and a volume of 40π cm^3.
Cone B has a radius of 12 cm and a height of 20 cm.



Cone A Cone B

(a) Calculate the volume of Cone B, leaving your answer in exact form.

Answer ..... cm^3 [2]

(b) Hence, determine if Cone A is similar to Cone B. Explain your answer.

Answer

.....

..... [3]

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18 A flower shop sells 3 different types of bouquets, consisting of different types of flowers, for various occasions. The number for each type of flowers in each bouquet is shown in the table below.

Type of bouquet / Type of flowers	Tulip	Carnation	Hydrangea	Rose
Birthday	3	5	2	4
Promotion	5	4	1	3
Get Well Soon	5	7	0	2

The cost price of a stalk of tulip, carnation, hydrangea and rose is \$1.20, \$0.90, \$1.50 and \$1.70 respectively.

This information can be represented by the matrix $\mathbf{C} = \begin{pmatrix} 1.20 \\ 0.90 \\ 1.50 \\ 1.70 \end{pmatrix}$.

(a) Represent the number of each type of flowers in each bouquet in a 3×4 matrix **F**.

Answer **F** = ... [1]

(b) Evaluate the matrix **P** = **FC**.

Answer **P** = ... [1]

(c) State what the elements of **P** represent.

.....

..... [1]

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(d) The flower shop wants to make a profit of 50%, 35% and 40% from the Birthday, Promotion and Get Well Soon bouquet respectively.
Using matrix multiplication only, find the selling price of each type of bouquet and represent it in a column matrix.

Answer ..... [2]

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19 The mass of some crystals were measured and the results are shown in the stem-and-leaf diagram.

1	5	7	7	8
2	1	3		
3	2	2	5	8
4	0	1		

Key 2 | 4 means 240 g

(a) Find the median mass.

Answer ..... g [1]

(b) Find the standard deviation of the mass.

Answer ..... g [1]

(c) A crystal is chosen at random. Calculate the probability of the crystal having a mass of at least 350 g.

Answer ..... [1]

(d) It was discovered that the mass has been measured incorrectly. The correct mass were all 20 g more than those recorded.
Explain how the median and standard deviation of the mass have been affected by this error.

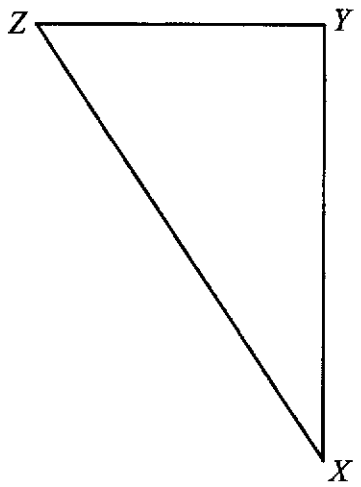
.....

.....

..... [2]

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20 The scale drawing below shows the locations of Village *X*, *Y* and *Z*.
The distance between Village *X* and *Y* is 600 m and *XY* is perpendicular to *YZ*.



(a) A waterfall is equidistant from the lines *XZ* and *YZ*, and equidistant from Village *X* and *Y*.
By constructing bisectors, find and label the position of the waterfall, *W*. [2]

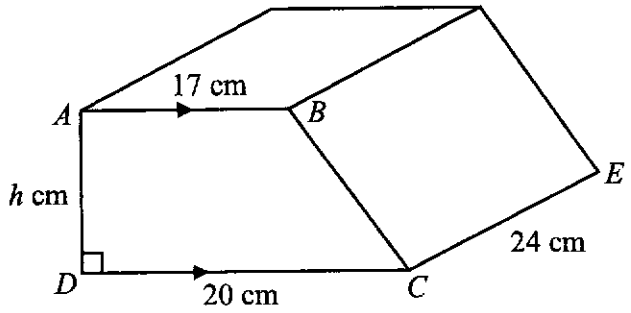
(b) Shade the region inside triangle *XYZ* that is closer to *YZ* than *XZ*. [1]

(c) Calculate the **actual** area of the shaded region, giving your answer in square metres.

Answer ..... m^2 [2]

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21 The diagram shows a solid in the shape of a prism.
The cross-section of the prism is a trapezium $ABCD$ with height h cm.
$AB = 17$ cm, $CD = 20$ cm and $CE = 24$ cm. The volume of the prism is 6660 cm^3.



(a) Find the value of h.

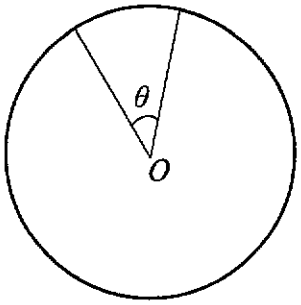
Answer h = ... [3]

(b) The solid is made from a material with density 2500 g/m^3.
Calculate the mass of the solid, in grams.

Answer ..... g [2]

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22 The diagram shows a circle with centre O. The angle of the minor sector is θ radians.



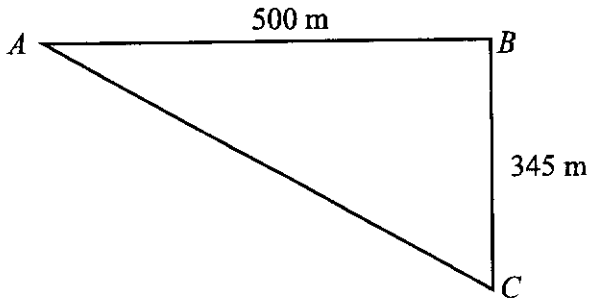
The perimeter of the major sector is three times the perimeter of the minor sector. Show that $\theta = 0.571$, correct to 3 significant figures.

Answer

[4]

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23 The diagram shows the position of three landmarks A, B and C.
C is due South of B and B is due East of A. $AB = 500$ m and $BC = 345$ m.



(a) Find the bearing of C from A.

Answer ..... ° [2]

(b) There is a clock tower at landmark B. The height of the clock tower is 64 m.
Justin walks from landmark A to C.
Calculate the greatest angle of elevation of the clock tower from Justin.

Answer ..... ° [3]

END OF PAPER

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Answer Key

1 **(a)** 2.75
(b) 1.49×10^8

2 **(a)** $2^2 \times 3^3 \times 5$
(b) $x = 5$
$y = 3$

3 **(a)** $\frac{3b^7}{a^4}$
(b) 6

4 90

5 $x = 5$
$y = 8$

6 $x = \pm\sqrt{\frac{k}{9+y}}$

7 refer to mark scheme

8 **(a)** $13x - 18y$
(b) $3p^2 + 12p + 4$

9 **(a)** 13.05 km
(b) 105.12 cm^2

10 15

11 **(a)** $F = \frac{22}{d^2}$
(b) 2.71

12 **(a)** $x(3x+7)(2x-1)$
(b) $\frac{8x+15}{(2x+5)(2x-5)}$

13 **(a)** $(x-3)^2 - 16$
(b) curve sketch

14 **(a)** 36, 44
(b) $8n + 12$
(c) refer to mark scheme

15 **(a)** refer to mark scheme
(b) $\frac{5}{9}x$

16 **(a)** $k = 7$

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$a = 3$

(b) $y = -28x + 7$

(c) $y = -28x + k$, where k is any real number except 7

17 **(a)** 960π

(b) Not similar. refer to mark scheme.

18 **(a)** $\begin{pmatrix} 3 & 5 & 2 & 4 \\ 5 & 4 & 1 & 3 \\ 5 & 7 & 0 & 2 \end{pmatrix}$

(b) $\begin{pmatrix} 17.90 \\ 16.20 \\ 15.70 \end{pmatrix}$

(c) The elements of P represent the cost price of a Birthday, Promotion and Get Well Soon bouquet respectively.

(d) $\begin{pmatrix} 26.85 \\ 21.87 \\ 21.98 \end{pmatrix}$

19 **(a)** 275

(b) 94.6

(c) $\frac{1}{3}$

(d) The median mass should be 20 g more, which is 295 g, but the standard deviation would remain unchanged.

20 **(a)** refer to mark scheme

(b) refer to mark scheme

(c) 44 000 m^2

21 **(a)** 15

(b) 16.65

22 refer to mark scheme

23 **(a)** 124.6

(b) 12.7

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Parent's/Guardian's Signature:

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

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

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

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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]

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(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]

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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]

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(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]

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(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.

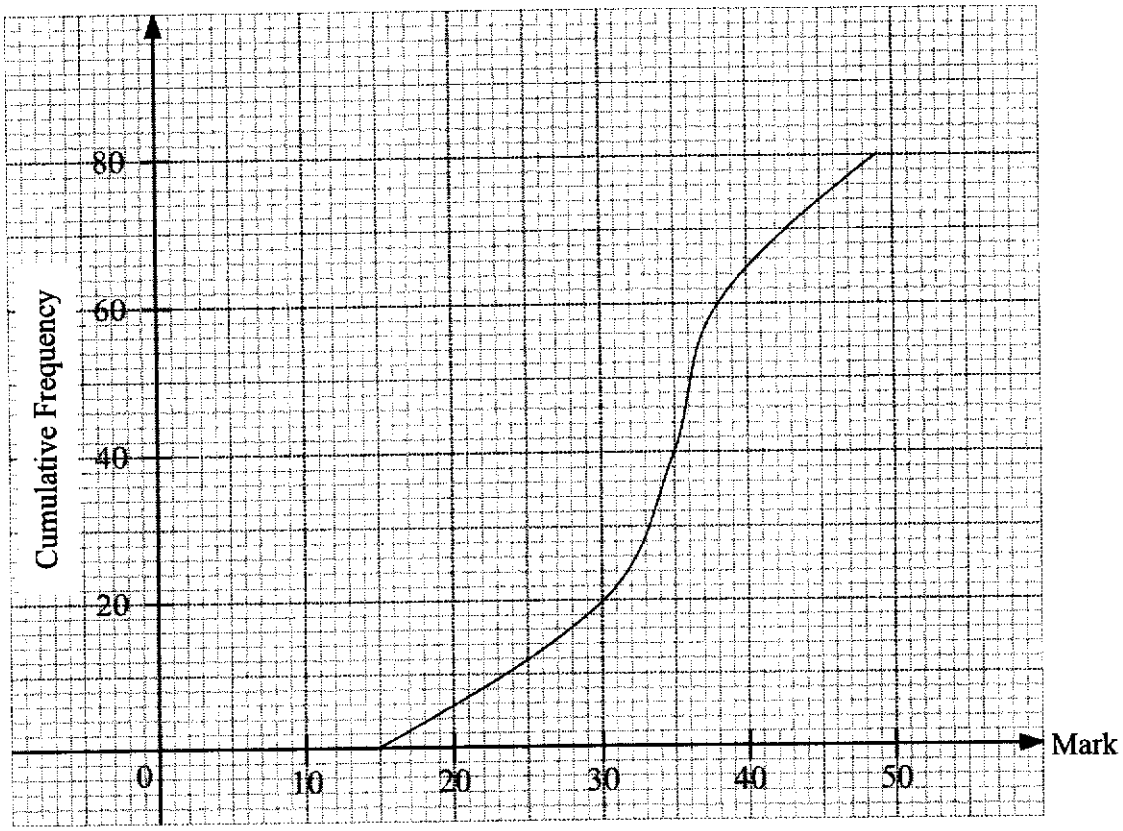
Jude books 2 nights at The Grand New York and 3 nights at The Ontario Inn using his credit card.
The credit card company converts the prices to Singapore dollars and Jude is charged a fee of 1.5% for the currency conversion.

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

Answer S$..... [3]

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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.

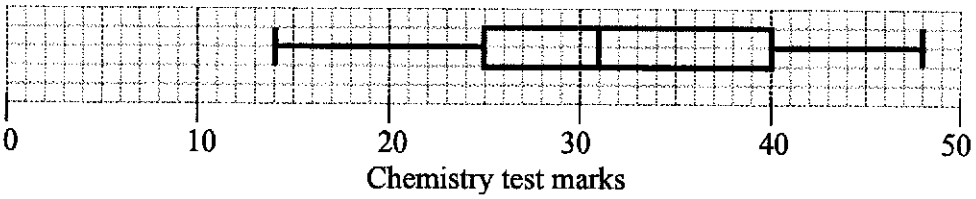
Answer ..... [1]

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(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]

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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]

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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

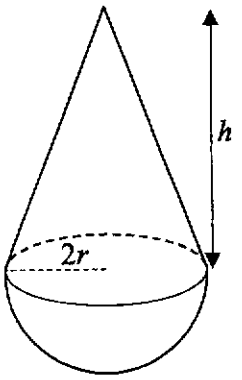
[4]

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

Answer ..... [2]

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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]

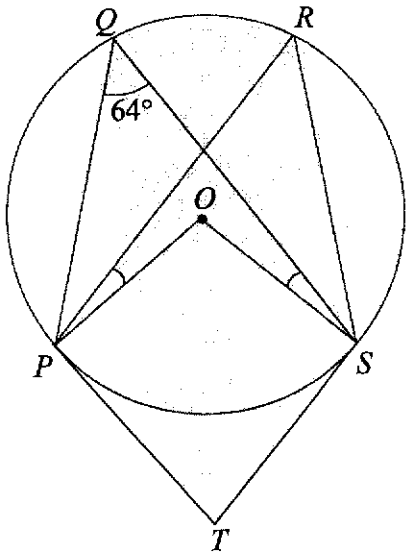
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(b) The volume of the hemisphere is 450 cm^3.
Find the total surface area of the solid.

Answer .....cm^2 [5]

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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]

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(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]

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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.

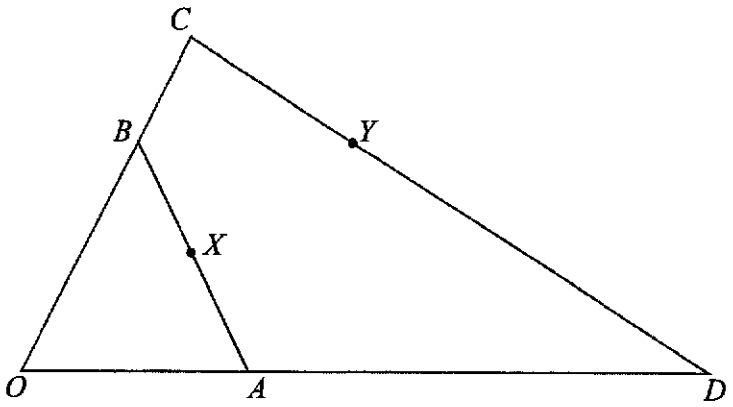
Equation of BC is $x = 1$, and C lies on the x-axis.

Find the area of triangle ABC.

Answer .....units^2 [4]

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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]

[Turn over

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(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 $-3 \le x \le 3$. [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.

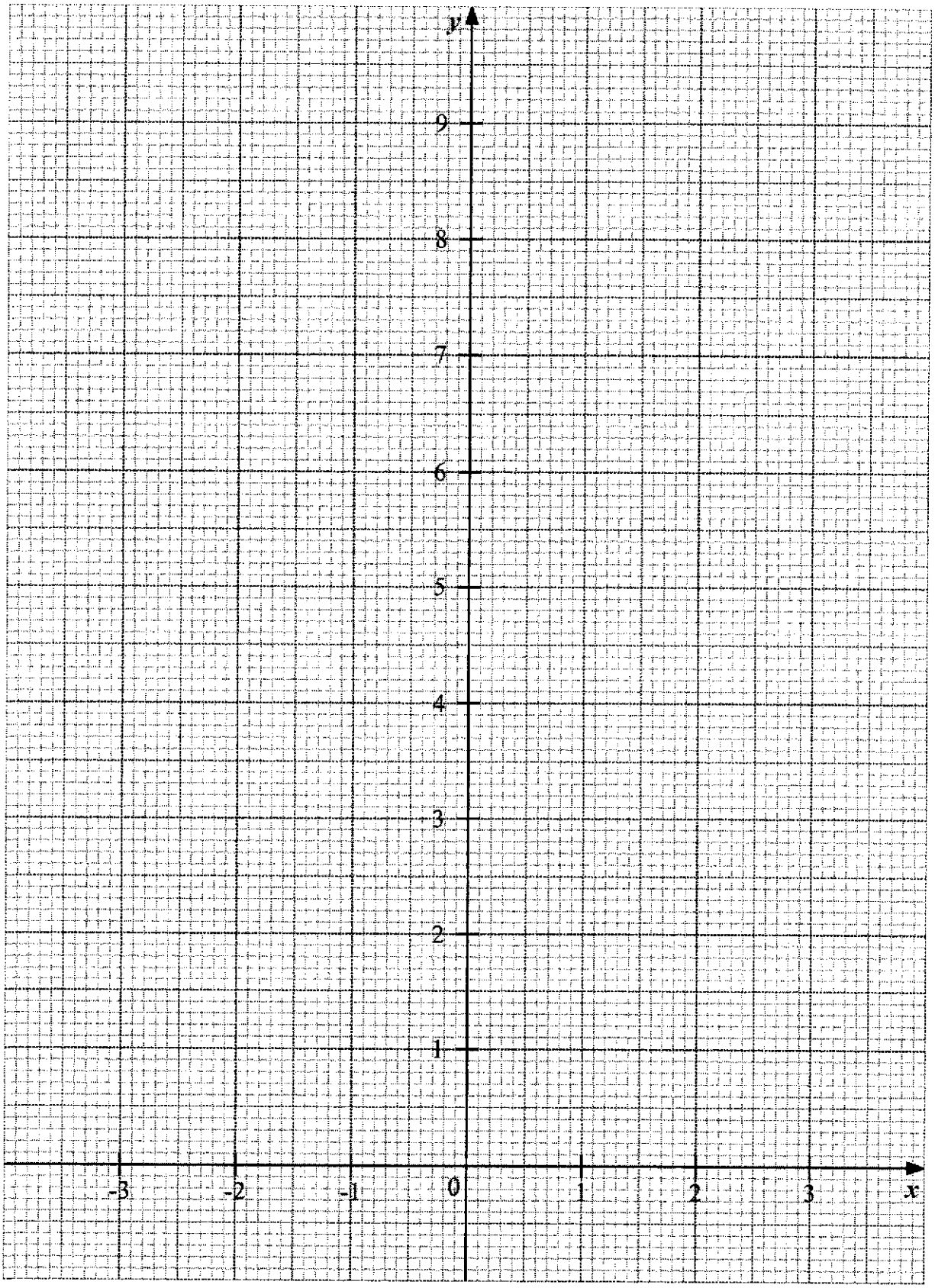
Use your graph to estimate the value of k.

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]

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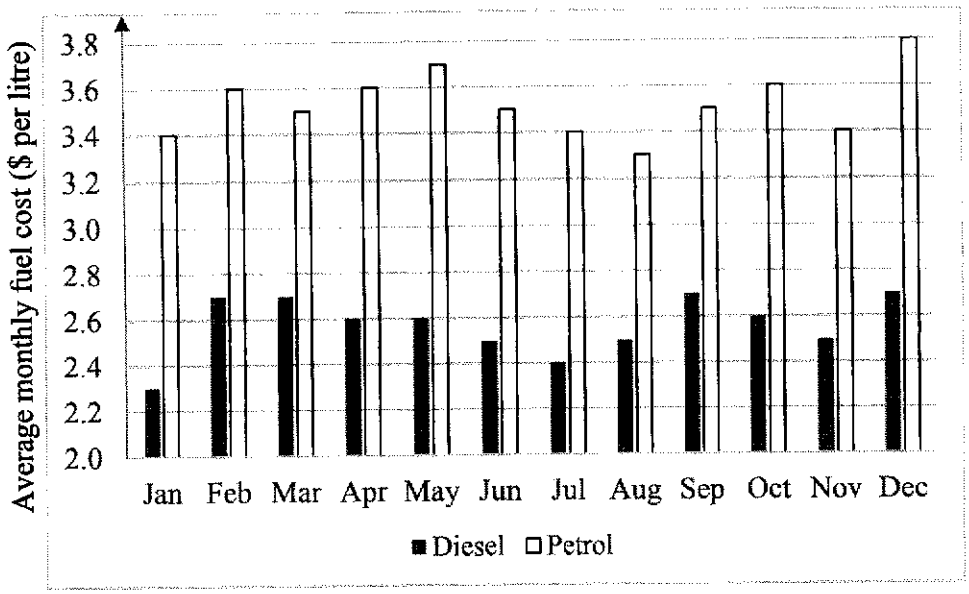


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9 Ean, who lives with 5 other adult members in his family, plans to purchase a car which could accommodate the whole family.
He did some research and found the following information:

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]

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(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

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

.....

.....

.....[7]

— End of Paper—

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

CANDIDATE NAME

CLASS | | | | INDEX NUMBER | | |

MATHEMATICS 4052/01

Secondary 4 Express

21 August 2024

Setter: Ms Low Yan Jin
Vetter: Ms Vanessa Chia
Moderator: Mr Johnson Chua

2 hour 15 minutes

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		[redacted]	
Presentation		[redacted]	

For Examiner's Use

90

Parent's/Guardian's Signature:

This document consists of **20** printed pages.

[Turn over

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Mathematical Formulae

Compound Interest

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

Mensuration

Curved surface area of a cone = πrl

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

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

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

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

Arc length = $r\theta$, where θ 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

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

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

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Answer **all** the questions.

1 Evaluate

(a) $\dfrac{8.75}{\sqrt{4.86+0.982}}$, correct to 2 decimal places,

$= 2.7459$

$= 2.75$ *

Answer ..... 2.75 — (B1) ..... [1]

(b) $\left(5.87\times10^{6}\right)\div\left(3.94\times10^{-2}\right)$, leaving your answer in standard form, correct to 3 significant figures.

$= 1.4898 \times 10^{8}$

$= 1.49 \times 10^{8}$ *

Answer ..... 1.49×10^{8} — (B1) ..... [1]

---

2 **(a)** Express 540 as a product of its prime factors.

$540 = 2^{2} \times 3^{3} \times 5$

Answer ..... $2^{2} \times 3^{3} \times 5$ — (B1) ..... [1]

(b) The number $\dfrac{540x}{y}$ is a perfect square, where x and y are prime numbers and $x > y$. Find the value of x and of y.

Answer $x =$ ..... 5 .....

$y =$ ..... 3 ..... (B1) [1]

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3 (a) Simplify $24a^2b^5 \div 8a^6b^{-2}$. Leave your answer in positive index form.

$= 3a^{-4}b^7$

$= \frac{3b^7}{a^4}$ #

↑ penalise under simplification.
* Note that this is usually not the case - will be OM.

Answer $\frac{3b^7}{a^4}$ — (B1) [1]

(b) Given that $9^k \times \frac{1}{729} = 3^k$, find the value of k.

$\frac{(3^2)^k}{3^{2k}} \times \frac{1}{3^6} = 3^k$ — (M1) : both correct

$3^{2k} \times 3^{-6} = 3^k$

$3^{2k-6} = 3^k$

$2k - 6 = k$

$k = 6$ #

Answer $k =$ 6 — (A1) [2]

---

4 During a school's anniversary, Joey sold x cookies at 50 cents each and $(x + 30)$ chocolates at 90 cents each. Form an inequality in x and solve it to find the minimum value of x in order for her to receive at least \$152 from the sales.

$50x + 90(x+30) \geq 15200$ — (M1): correct inequality

$50x + 90x + 2700 \geq 15200$

$140x \geq 12500$

$x \geq 89.285$ — (M1): for simplification

$x \geqslant 90$ #
↳ If students put $\geq$, penalise under presentation at cover page

DM1:

$0.5x + 0.9(x+30) \geq 152$ — [M1].

$0.5x + 0.9x + 27 \geq 152$

$1.4x \geq 125$

$x \geq 89.285$ — [M1]

$x = 90$

Answer $x =$ 90 — (A1) [3]

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5 Solve the simultaneous equations.

$$x+3y=29$$
$$2x=5y-30$$

Elimination:

$2x + 6y = 58$ — ①
$2x - 5y = -30$ — ②

① − ②: $(2x+6y)-(2x-5y) = 58-(-30)$ } (M1): elimination

$11y = 88$
$y = 8$ *
$2x - 5(8) = -30$
$2x = 10$
$x = 5$ *

Substitution:

$x = 29-3y$ — ①
$2x = 5y-30$ — ②
sub ① into ②,
$2(29-3y) = 5y-30$ — (M1): substitution
$58-6y = 5y-30$
$11y = 88$
$y = 8$ *
$x = 29-3(8)$
$= 5$ *

Answer $x =$ 5 — (A1)

$y =$ 8 — (A1) [3]

---

6 Rearrange the formula $10+y=\dfrac{x^2+k}{x^2}$ to make x the subject.

$x^2(10+y) = x^2+k$ — (M1)
$10x^2+yx^2 = x^2+k$
$9x^2+yx^2 = k$
$x^2(9+y) = k$
$x^2 = \dfrac{k}{9+y}$ — (M1)
$x = \pm\sqrt{\dfrac{k}{9+y}}$ *

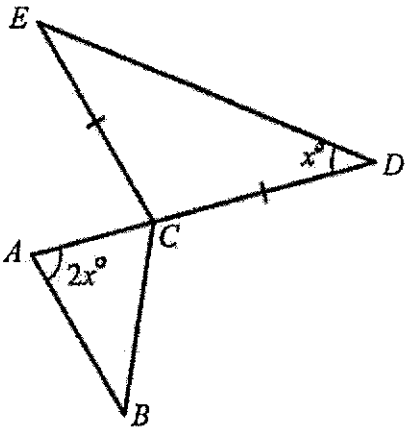
CAUTION:

$10+y = 1+\dfrac{k}{x^2}$ — [M1]
$9+y = \dfrac{k}{x^2}$
$x^2 = \dfrac{k}{9+y}$ — [M1]
$x = \pm\sqrt{\dfrac{k}{9+y}}$

Answer $x = \pm\sqrt{\dfrac{k}{9+y}}$ — (A1) [3]

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7 In the figure, ACD is a straight line and $CD = CE$.
Angle $CDE = x°$ and angle $CAB = 2x°$.
Determine if AB is parallel to CE, stating your reasons clearly.



Answer

$\angle CED = x°$ (base $\angle$s of isos. $\triangle$)
$\angle ECA = 2x°$ (ext. $\angle$ of $\triangle$) } (M1)

Note: –1M from 1st if reasons are wrong/missing.

Since $\angle ECA = \angle CAB = 2x°$, by alternate $\angle$s, // lines, $AB \parallel CE$. — (A1)

..... [2]

---

8 Simplify.

(a) $5(3x-2y)-2(x+4y)$

$= 15x - 10y - 2x - 8y$ — (M1): either correct

$= 13x - 18y$

Answer $13x - 18y$ — (A1) [2]

(b) $12p^2+8-(3p-2)^2$

$= 12p^2 + 8 - (9p^2 - 12p + 4)$ — (M1)

$= 12p^2 + 8 - 9p^2 + 12p - 4$

$= 3p^2 + 12p + 4$ #

Answer $3p^2 + 12p + 4$ — (A1) [2]

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9 A map of Mount Fuji has a scale of 1 : 25 000.

(a) The length of a trail on the map is 52.2 cm.
Calculate the actual length, in kilometres, of the trail.

1 : 25 000
52.2 : 1305 000 — (M1)
1305 000 cm = 13.05 km ✱

Answer ..... 13.05 — (A1) .... km [2]

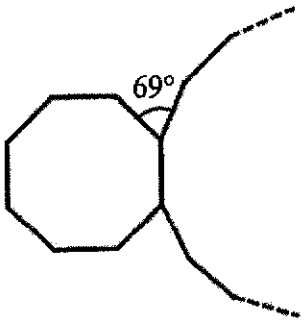
(b) A lake at the base of Mount Fuji has an actual area of 6.57 km^2.
Calculate the area, in square centimetres, of the lake on the map.

1cm : 0.25 km.
1cm^2 : 0.0625 km^2 — (M1)
105.12cm^2 : 6.57 km^2 ✱

Answer ..... 105.12 — (A1) ... cm^2 [2]

---

10 The diagram shows a regular octagon (8-sided) and a *n*-sided polygon.



Find the value of *n*.

Each int. ∠ = $\frac{(8-2)\times 180^\circ}{8}$ — (M1)
= 135°.

n-sided int ∠ = 360° − 69° − 135° — (M1) (ecf)
= 156°.

Each ext. ∠ = 180° − 156°
= 24°.

$n = \frac{360^\circ}{24^\circ}$ — (M1) (ecf)
= 15 ✱

[M1]:
$\frac{(n-2)\times 180^\circ}{n} = 156$ — [M1] (ecf)
$(n-2)\times 180^\circ = 156n$
$180n - 360^\circ = 156n$
$24n = 360^\circ$
$n = 15$.

Answer n = ... 15 — (A1) ..... [4]

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11 The force, F Newtons, between two particles is inversely proportional to the square of the distance, d cm, between them.
If the force is 5.5 Newtons when the distance between the two particles is 2 cm, find

(a) an equation connecting F and d,

$F = \frac{k}{d^2}$

$5.5 = \frac{k}{2^2}$ — (M1)

$k = 22$.

$\therefore F = \frac{22}{d^2}$ *

Answer ..... $F = \frac{22}{d^2}$ — (A1) ..... [2]

(b) the distance between two particles when the force is 3 Newtons.

$3 = \frac{22}{d^2}$

$d^2 = \frac{22}{3}$

$d = \sqrt{\frac{22}{3}}$

$= 2.7080$

$= 2.71$ *

Answer ..... 2.71 — (B1) ..... cm [1]

---

12 **(a)** Factorise $6x^3 + 11x^2 - 7x$.

$= x(6x^2 + 11x - 7)$ — (M1)

$= x(3x+7)(2x-1)$ *

$3x$	7	$14x$
$2x$	-1	$-3x$
$6x^2$	-7	$11x$

Answer ..... $x(3x+7)(2x-1)$ — (A1) ..... [2]

(b) Write as a single fraction in its simplest form $\frac{2x}{4x^2-25} + \frac{3}{2x-5}$.

$\frac{2x}{(2x+5)(2x-5)} + \frac{3}{2x-5}$ — (M1) : Factorise $4x^2-25$.

$= \frac{2x + 3(2x+5)}{(2x+5)(2x-5)}$ — (M1) : combining both fractions

$= \frac{2x + 6x + 15}{(2x+5)(2x-5)}$

$= \frac{8x+15}{(2x+5)(2x-5)}$ *

$= \frac{4x^2 - 10x + 10x^2 - 75}{(2x+5)(2x-5)(2x-5)}$ — (M1)

$= \frac{16x^2 - 10x - 75}{(2x+5)(2x-5)^2}$

$= \frac{(8x+15)(2x-5)}{(2x+5)(2x-5)^2}$

$= \frac{8x+15}{(2x+5)(2x-5)}$

Answer ..... $\frac{8x+15}{(2x+5)(2x-5)}$ — (A1) or $\left(\frac{8x+15}{4x^2-25}\right)$ ..... [3]

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13 **(a)** Express x^2-6x-7 in the form $(x-p)^2-q$.

$x^2-6x-7 = x^2-2(x)(3)+3^2-3^2-7$

$= (x-3)^2-16$ ✱

[Alt]:

$(x-p)^2-q$

$= x^2-2px+p^2-q$

$\therefore -2px = -6x$, $p^2-q=-7$

$p = 3$ $3^2-q=-7$

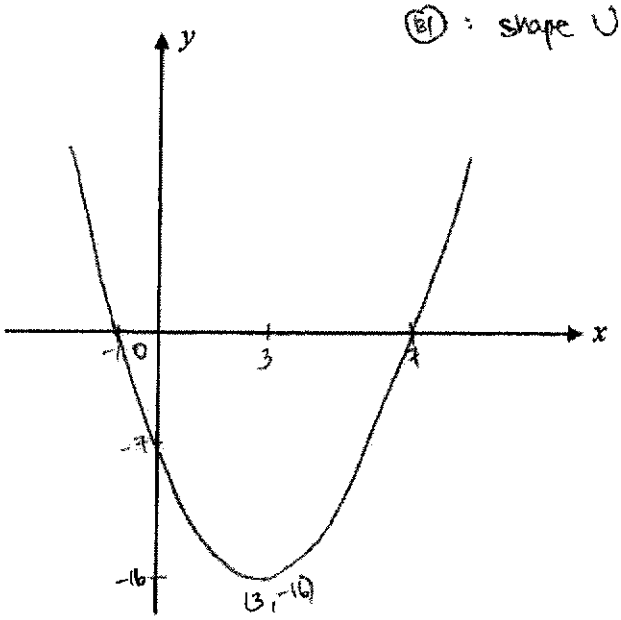
$q=16$.

Answer $(x-3)^2-16$ (B1) [1]

(b) Hence, or otherwise sketch the graph of $y=x^2-6x-7$ in the axes below.
Indicate clearly the values where the graph crosses the axes and the coordinates of the turning point on the curve.

(B1): x and y-int
(B1): turning point
(B1): shape ∪.

Answer [3]



$y = (x-3)^2-16$

when $x=0$,

$y=-7$

when $y=0$,

$(x-3)^2-16=0$

$(x-3)^2=16$

$x-3=\pm 4$

$x=7$ or $x=-1$.

$Tp = (3,-16)$.

[Alt]:

$y=(x-7)(x+1)$

when $y=0$,

$x=7$ or $x=-1$.

$x_{tp} = \frac{7+(-1)}{2}$

$= 3$.

$y_{tp} = 3^2-6(3)-7$

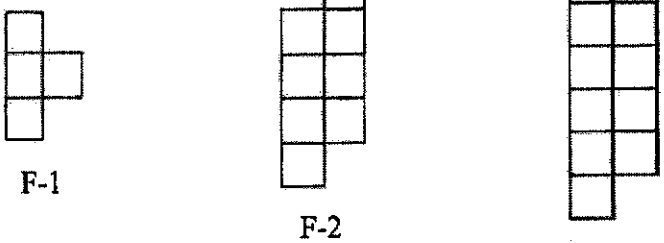
$= -16$.

$\therefore Tp = (3,-16)$

when $x=0$, $y=-7$

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14 A F-1 block is made up of 4 squares of sides 2 cm each.
The F-1 blocks can be combined to form more blocks and F-2 and F-3 blocks are shown below.



F-1

F-2

F-3

(a) Complete the table.

Block	F-1	F-2	F-3	F-4
Perimeter (cm)	20	28	36	44

(B1) [1]

(b) Write down an expression, in terms of n, for the perimeter of a F-n block.

Answer $8n + 12$ — (B1) cm [1]

(c) Hence, explain if it is possible to have a block with a perimeter of 100 cm.

Answer

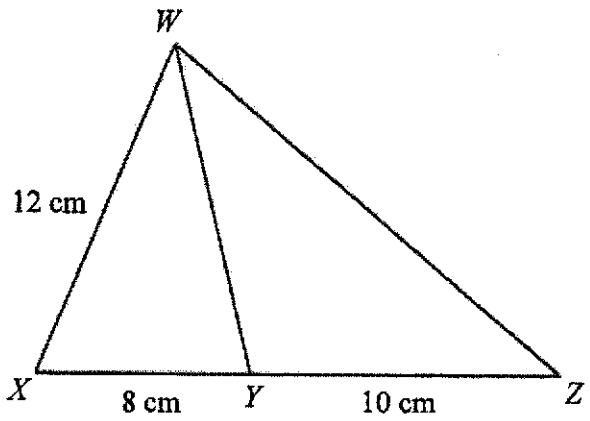
$8n + 12 = 100$
$8n = 88$
$n = 11$. } (M1)

Since n is an integer (A1), it is possible to have a block with perimeter of 100 cm, F-11 block. [2]

[AH]:
It is possible to have a block with a perimeter of 100cm. It happens when F-11 blocks. [AH]

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15 In the diagram, WXZ is a triangle. $WX = 12$ cm, $XY = 8$ cm and $YZ = 10$ cm.



(a) Show that triangles WXY and ZXW are similar.

Answer

$\frac{XY}{XW} = \frac{8}{12} = \frac{2}{3}$

$\angle WXY = \angle ZXW$ (common $\angle$) } (M1)

$\frac{XW}{XZ} = \frac{12}{18} = \frac{2}{3}$.

$\therefore \triangle WXY$ is similar to $\triangle ZXW$ (SAS similarity)

(A1)

[2]

(b) If the area of triangle ZXW is x cm^2, find the area of triangle WYZ in terms of x.

$\frac{A_S}{A_B} = \frac{B_S}{B_B}$

$\frac{A_S}{x} = \frac{10}{18}$ — (M1)

$A_S = \frac{10}{18}x$

$= \frac{5}{9}x$ #

[Alt]:

Let the height of $\triangle ZXW$ be h.

$\frac{1}{2}(h)(18) = x$

$h = \frac{x}{9}$ — [M1]

$\therefore$ Area of $\triangle WYZ = \frac{1}{2}(10)\left(\frac{x}{9}\right)$

$= \frac{5}{9}x$ #

[Alt]:

$\frac{A_S}{A_B} = \left(\frac{2}{3}\right)^2$

$= \frac{4}{9}$ — [M1]

$\frac{A_S}{x} = \frac{4}{9}$

$A_S = \frac{4}{9}x$

area of $\triangle WYZ = x - \frac{4}{9}x$

$= \frac{5}{9}x$

[Alt]:

$A_S : A_B$

$4 : 9$

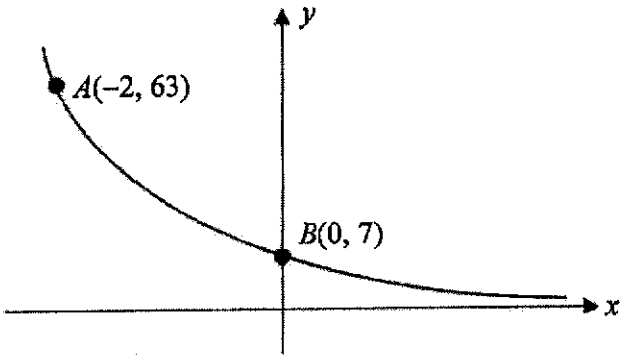
$9u \longrightarrow x$

$5u \longrightarrow \frac{5}{9}x$

Answer ..... $\frac{5}{9}x$ — (A1) ..... cm^2 [2]

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16 The sketch shows the graph of $y = ka^{-x}$. The points $A(-2, 63)$ and $B(0, 7)$ lie on the graph.



(a) Find the values of k and of a.

$7 = ka^{-0}$

$k = 7$ ✱

$\therefore y = 7a^{-x}$

$63 = 7a^{-(-2)}$ — (M1)(eqn)

$63 = 7a^2$

$a^2 = 9$

$a = 3$ ✱

Answer $k =$ 7 — (A1)

$a =$ 3 — (M1) [3]

(b) Find the equation of the line AB.

$m_{AB} = \frac{63-7}{-2}$ — (M1)

$= -28$

$\therefore y = -28x + 7$ ✱

Answer $y = -28x + 7$. — (A1) [2]

(c) Write down a possible equation of a line that does not intersect the line AB.

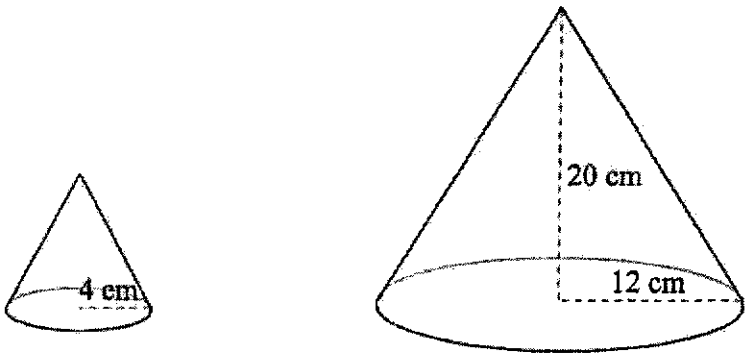
Answer $y = -28x + K$ (A1) [1]

where $K \in \mathbb{R}$, $K \neq 7$.

eg. $y = -28x + 1$.

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17 Cone A has a radius of 4 cm and a volume of 40π cm^3.
Cone B has a radius of 12 cm and a height of 20 cm.



Cone A Cone B

(a) Calculate the volume of Cone B, leaving your answer in exact form.

Volume $= \frac{1}{3}\pi(12)^2(20)$ — (M1)
$= 960\pi$.

Answer 960π — (A1) cm^3 [2]

(b) Hence, determine if Cone A is similar to Cone B. Explain your answer.

Answer

$\left(\frac{h_A}{h_B}\right)^3 = \left(\frac{4}{12}\right)^3$ — (M1)
$= \frac{1}{27}$

$\frac{V_A}{V_B} = \frac{40\pi}{960\pi}$ — (M1) (ecf)
$= \frac{1}{24}$

[M1]:
$\frac{1}{3}\pi(4)^2 h = 40\pi$
$h = 7.5$. — [M1]

$\frac{r_A}{r_B} = \frac{4}{12} = \frac{1}{3}$.
$\frac{H_A}{H_B} = \frac{7.5}{20} = \frac{3}{8}$.
} [M1].

since $\frac{r_A}{r_B} \neq \frac{H_A}{H_B}$, cone A is not similar to cone B. [A1].

or $\frac{1}{27} \neq \frac{1}{24}$.

Since $\frac{V_A}{V_B} \neq \left(\frac{h_A}{h_B}\right)^3$, Cone A is not similar to Cone B.
(A1)

[3]

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18 A flower shop sells 3 different types of bouquets, consisting of different types of flowers, for various occasions. The number for each type of flowers in each bouquet is shown in the table below.

Occasion / Type of flowers	Tulip	Carnation	Hydrangea	Rose
Birthday	3	5	2	4
Promotion	5	4	1	3
Get Well Soon	5	7	0	2

The cost price of a stalk of tulip, carnation, hydrangea and rose is \$1.20, \$0.90, \$1.50 and \$1.70 respectively.

This information can be represented by the matrix $\mathbf{C} = \begin{pmatrix} 1.20 \\ 0.90 \\ 1.50 \\ 1.70 \end{pmatrix}$.

(a) Represent the number of each type of flowers in each bouquet in a 3×4 matrix **F**.

Answer **F** = $\begin{pmatrix} 3 & 5 & 2 & 4 \\ 5 & 4 & 1 & 3 \\ 5 & 7 & 0 & 2 \end{pmatrix}$ (B1) [1]

(b) Evaluate the matrix **P** = **FC**.

$P = \begin{pmatrix} 3 & 5 & 2 & 4 \\ 5 & 4 & 1 & 3 \\ 5 & 7 & 0 & 2 \end{pmatrix} \begin{pmatrix} 1.20 \\ 0.90 \\ 1.50 \\ 1.70 \end{pmatrix}$

$= \begin{pmatrix} 14.90 \\ 16.20 \\ 15.70 \end{pmatrix}$ *

Note: no need to penalise if no 2dp shown.

Answer **P** = $\begin{pmatrix} 14.90 \\ 16.20 \\ 15.70 \end{pmatrix}$ (B1) [1]

(c) State what the elements of **P** represent.

The elements of P represent the cost price of a Birthday, Promotion and Get well soon bouquet respectively. (B1) [1]

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(d) The flower shop wants to make a profit of 50%, 35% and 40% from the Birthday, Promotion and Get Well Soon bouquet respectively.
Using matrix multiplication only, find the selling price of each type of bouquet and represent it in a column matrix.

$$\underbrace{\begin{pmatrix} 1.5 & 0 & 0 \\ 0 & 1.35 & 0 \\ 0 & 0 & 1.4 \end{pmatrix}\begin{pmatrix} 17.90 \\ 16.20 \\ 15.70 \end{pmatrix}}_{\text{(M1) (ecf)}} = \begin{pmatrix} 26.85 \\ 21.87 \\ 21.98 \end{pmatrix} *$$

Answer $\begin{pmatrix} 26.85 \\ 21.87 \\ 21.98 \end{pmatrix}$ —(A1) [2]

Acceptable accuracy if left in 10¢.

[AM]:

$$\underbrace{\begin{pmatrix} 17.90 & 16.20 & 15.70 \end{pmatrix}\begin{pmatrix} 1.5 & 0 & 0 \\ 0 & 1.35 & 0 \\ 0 & 0 & 1.40 \end{pmatrix}}_{\text{[M1] (ecf)}} = \begin{pmatrix} 26.85 & 21.87 & 21.98 \end{pmatrix}$$ — NO [A0]

$$\underbrace{\begin{pmatrix} 17.9 & 0 & 0 \\ 0 & 16.2 & 0 \\ 0 & 0 & 15.7 \end{pmatrix}\begin{pmatrix} 1.5 \\ 1.35 \\ 1.4 \end{pmatrix}}_{\text{[M1] (ecf)}} = \begin{pmatrix} 26.85 \\ 21.87 \\ 21.98 \end{pmatrix}$$

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19 The mass of some crystals were measured and the results are shown in the stem-and-leaf diagram.

1	5	7	7	8
2	1	3		
3	2	2	5	8
4	0	1		

Key 2 | 4 means 240 g

(a) Find the median mass.

Median = $\frac{230 + 320}{2}$

= 275 g *

Answer 275 — (B1) g [1]

(b) Find the standard deviation of the mass.

Answer 94.6 — (B1) g [1]

(c) A crystal is chosen at random. Calculate the probability of the crystal having a mass of at least 350 g.

$\frac{4}{12} = \frac{1}{3}$

Answer $\frac{1}{3}$ — (B1) [1]

(d) It was discovered that the mass has been measured incorrectly. The correct mass were all 20 g more than those recorded.
Explain how the median and standard deviation of the mass have been affected by this error.

* need to state the increase / (B1) either correct.

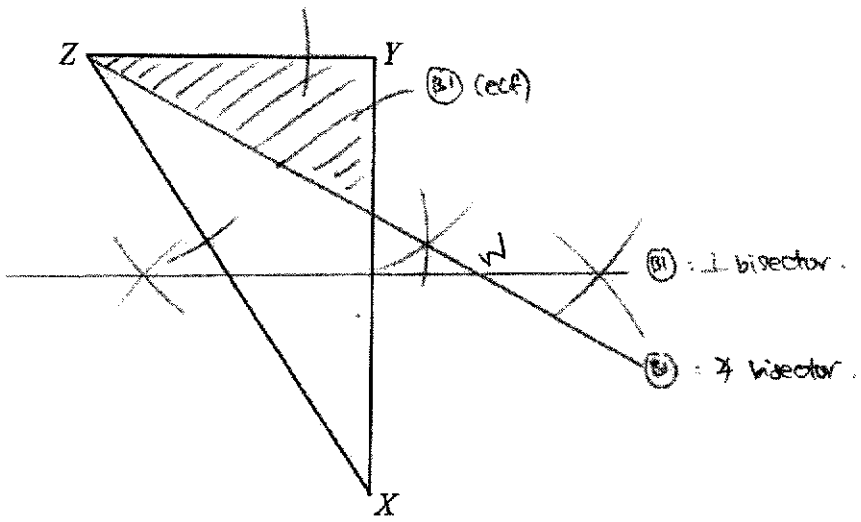
The median mass should be 20g more, which is 295g, but the standard deviation would remain unchanged.

(B1)

[2]

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20 The scale drawing below shows the locations of Village X, Y and Z.
The distance between Village X and Y is 600 m and XY is perpendicular to YZ.



(a) A waterfall is equidistant from the lines XZ and YZ, and equidistant from Village X and Y.
By constructing bisectors, find and label the position of the waterfall, W. [2]

(b) Shade the region inside triangle XYZ that is closer to YZ than XZ. [1]

(c) Calculate the **actual** area of the shaded region, giving your answer in square metres.

6cm = 600m
1cm = 100m
(±0.1) 2.2cm = 220m
(±0.1) 4cm = 400m (M1): either correct

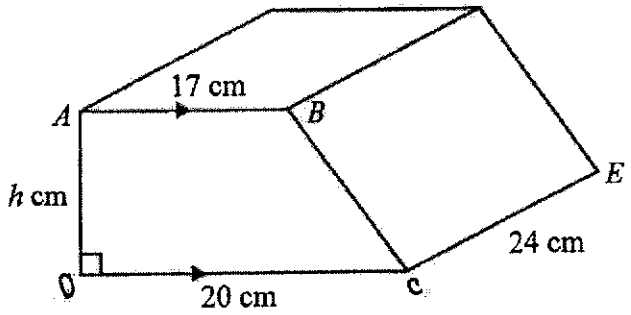
∴ Actual area = $\frac{1}{2} \times 220 \times 400$
= 44 000 m²

[Alt]:
1cm : 100m
1cm² : 10000m² — [M1]
Area = $\frac{1}{2} \times 4 \times 2.2 = 4.4\ cm^2$ (±0.1)
Actual area = 4.4 × 10000
= 44 000 m² #

Answer 44 000 — (A1) m² [2]
(accept: 40950/42000/42900/43050/44850/45100/46000/49150)

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21 The diagram shows a solid in the shape of a prism.
The cross-section of the prism is a trapezium $ABCD$ with height h cm.
$AB = 17$ cm, $CD = 20$ cm and $CE = 24$ cm. The volume of the prism is 6660 cm^3.



(a) Find the value of h.

Area of trapezium $= \frac{1}{2} \times (17 + 20) \times h$ — (M1) : area of trapezium.
$= 18.5h$.

$18.5h \times 24 = 6660$ — (M1) : volume of prism.
$18.5h = 277.5$
$h = 15$ #

Answer $h =$ ..... 15 — (A1) ..... [3]

(b) The solid is made from a material with density 2500 g/m^3.
Calculate the mass of the solid, in grams.

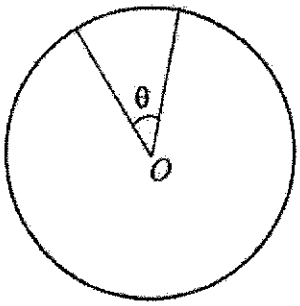
$1 cm = 0.01 m$
$1 cm^3 = 0.000\,001\ m^3$ — (M1)
$6660 cm^3 = 0.00666 m^3$
$\therefore$ Mass $= 2500 \times 0.00666$
$= 16.65 g$ #

CAUTION.
2500g ⟶ $1 m^3 = 1000000 cm^3$ — [M1].
16.65g ⟶ $6660 cm^3$

Answer ..... 16.65 — (A1) ..... g [2]
(or $16\frac{13}{20}$)

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22 The diagram shows a circle with centre O. The angle of the minor sector is θ radians.



The perimeter of the major sector is three times the perimeter of the minor sector. Show that $\theta = 0.571$, correct to 3 significant figures.

Answer

Major sector $= r(2\pi - \theta) + 2r$ — (M1)

Minor sector $= r\theta + 2r$ — (M1)

$\therefore 3(r\theta + 2r) = r(2\pi - \theta) + 2r$ — (M1) (eqn)

$3r\theta + 6r = 2\pi r - r\theta + 2r$

$4r\theta + 4r = 2\pi r$

$4r(\theta + 1) = 2\pi r$

$\theta + 1 = \frac{2\pi r}{4r}$

$\theta + 1 = \frac{\pi}{2}$

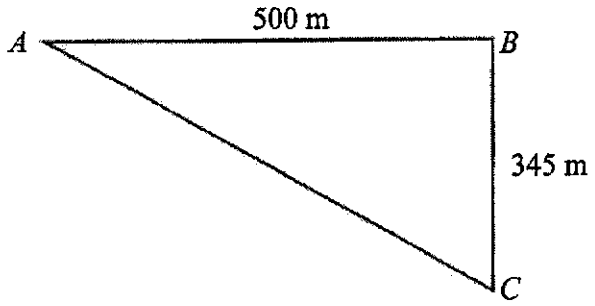
$\theta = 0.57079$

$\theta = 0.571$ (shown)* } (A1)

[4]

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23 The diagram shows the position of three landmarks A, B and C.
C is due South of B and B is due East of A. $AB = 500$ m and $BC = 345$ m.



(a) Find the bearing of C from A.

$\tan\theta = \frac{345}{500}$ — (M1)

$\theta = 34.605°$

Bearing $= 90° + 34.605°$

$= 124.60$

$= 124.6°$ #

* penalise accuracy if not in 1dp

Answer .....124.6..... (A1) ..... ° [2]

(b) There is a clock tower at landmark B. The height of the clock tower is 64 m.
Justin walks from landmark A to C.
Calculate the greatest angle of elevation of the clock tower from Justin.

$\sin 34.605° = \frac{opp}{500}$ — (M1) (ecf)

$opp = 283.95$

$\tan\theta = \frac{64}{283.95}$ — (M1) (ecf)

$\theta = \tan^{-1}\left(\frac{64}{283.95}\right)$

$= 12.701$

$= 12.7°$ #

[ALT]

$\angle BCA = 180° - 90° - 34.605°$

$= 55.395°$.

$\sin 55.395° = \frac{opp}{345}$ — [M1] (ecf)

$opp = 345 \sin 55.395°$

$= 283.95$.

[ALT]:

Area of $\triangle ABC = \frac{1}{2} \times 500 \times 345$

$= 86250$.

$AC = \sqrt{500^2 + 345^2}$

$= 607.47$

$\frac{1}{2} \times 607.47 \times h = 86250$ — [M1]

$h = 283.96$

* penalise accuracy if not in 1dp

Answer .....12.7..... (A1) ..... ° [3]

END OF PAPER

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	Solution/ Mark Scheme
1	**(a)** $\frac{2x+7}{2}-\frac{7-x}{5}=0$ $\frac{2x+7}{2}=\frac{7-x}{5}$ $5(2x+7)=2(7-x)$ --- [M1] $10x+35=14-2x$ $12x=-21$ $x=-1\frac{3}{4}$ (also accept $-\frac{7}{4}$) --- [A1] Alternative $\frac{2x+7}{2}-\frac{7-x}{5}=0$ $5(2x+7)-2(7-x)=0$ --- [M1] $10x+35-14+2x=0$ $12x=-21$ $x=-1\frac{3}{4}$ (also accept $-\frac{7}{4}$) --- [A1]
	(b) $(2x-3)(x-4)=2$ $2x^2-11x+12=2$ $2x^2-11x+10=0$ ---[M1] $x=\frac{-(-11)\pm\sqrt{(-11)^2-4(2)(10)}}{2(2)}$ ---[M1] $x=\frac{11\pm\sqrt{41}}{4}$ $x=1.15$ or 4.35 --- [A1, A1]
	(c) $\frac{15x^2}{2y}\div\frac{3x^2y}{8}$ $=\frac{15x^2}{2y}\times\frac{8}{3x^2y}$ $=\frac{20}{y^2}$ --- [B1]

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(d)

$$\frac{ax+3bx-2a-6b}{a^2+ab-6b^2}$$

$$=\frac{x(a+3b)-2(a+3b)}{a^2+ab-6b^2}$$

$$=\frac{(a+3b)(x-2)}{(a+3b)(a-2b)}$$ --- [M1 for numerator; M1 for denominator]

$$=\frac{x-2}{a-2b}$$ --- [A1]

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	Solution/ Mark Scheme
2	**(a)** Each compound increases the principal amount, which in turn leads to greater interest being generated. Cody should invest in account A as it provides more frequent compounding than account B, hence, generating greater interest. OR Cody should invest in account A because the interest is calculated 12 times each year as compared to only once a year for Account B. Each time, the interest is calculated on a larger amount of money. Therefore, account A will generate greater interest. *Do not accept if students provide a calculated example and arrive at a conclusion just based on calculation. Key idea of more frequent compounding in account A, which will lead to more interest generated, should be featured in students' explanation.
	(b) $20000\left(1+\frac{x}{100}\right)^3 = 22823.32$ --- [M1] $\left(1+\frac{x}{100}\right)^3 = \frac{22823.32}{20000}$ $1+\frac{x}{100} = \sqrt[3]{\frac{22823.32}{20000}}$ --- [M1] $\frac{x}{100} = \sqrt[3]{\frac{22823.32}{20000}} - 1$ $x = 4.4999$ (5 s.f.) ≈ 4.5 (1 d.p.) --- [A1]
	(c)(i) $\frac{40}{100} \times \$156000 + 36 \times \$2800$ --- [M1] $= \$163200$ --- [A1]

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(c)(ii)

$\$156000(0.92)^3$ --- [M1]

$= \$121475.328$ (3 d.p.)

Method 1

$\frac{\$121475.328}{\$163200} \times 100\% = 74.433\%$ --- [M1]

$100\% - 74.433\% = 25.6\%$ (3 s.f.) --- [A1]

Method 2

loss incurred: $\$163200 - \$121475.328 = \$41724.672$

% loss: $\frac{\$41724.672}{\$163200} \times 100\%$ --- [M1]

$= 25.566\%$

$= 25.6\%$ (3 s.f.) ---[A1]

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(d)

Amount of S$ spent in America: $\$368\times2\times1.35=\$993.60$

[M1 for finding cost of hotel in US in SGD]

Amount of S$ spent in Canada: $\$250\times3\times\frac{1}{1.02}=\$735.2941$ (4 d.p.)

[M1 for finding cost of hotel in Canada in SGD]

Total amount spent: $\$993.60+\$735.2941+\frac{1.5}{100}\times(\$993.60+\$735.2941)=\$1754.82$

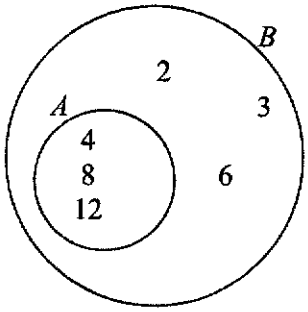
OR

$(\$993.60+\$735.2941)\times\frac{101.5}{100}=\$1754.82$

[A1] for either

	Solution/ Mark Scheme
3	**(a)(i)** Median mark = 35
	(a)(ii) $38-30$ --- [M1] $=8$ --- [A1]
	(a)(iii) 60^{th} percentile: $\frac{60}{100}\times 80 = 48$ From graph, 60^{th} percentile: 36 --- [B1]
	(b) $\frac{85}{100}\times 80 = 68$ --- [M1] $80-68=12$ 12 students scored less than x marks. From graph: $x=25$ ---[A1]
	(c)(i) Chemistry Test: Median mark: 32; IQR: $40-25=15$ Physics Test: Median mark: 35; IQR: 8 1. The students perform better for the Physics test due to a higher median mark of 35, as compared to the Chemistry test, with a lower median mark of 32. --- [B1] 2. The performance of the students were more consistent for the Physics test due to a lower interquartile range of 8, as compared to the Chemistry test, which has a higher interquartile range of 15. --- [B1] *Note: Students need to draw reference to the values of median/ IQR in their explanation to be awarded the mark.
	(c)(ii) The entire box-and-whisker plot would shift to the right by one unit/ one mark. --- [B1]

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	Solution/ Mark Scheme
4	$\xi = \{2,3,4,...15\}$ $A = \{4,8,12\}$ $B = \{2,3,4,6,8,12\}$ **(a)(i)** Elements in B': 5,7,9,10, 11,13,14,15 --- [B1] [Accept if students write: {5,7,9,10,11,13,14,15}]
	(a)(ii) *Note: A is a proper subset of B. Answer: 2,3,6 --- [B1] 
	(a)(iii) Answer: 0 --- [B1]

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(b)(i)

	Physics	Not Physics
Literature	*13* } [A1] for both correct	*5* ---[B1]
Not Literature	7 }	15

Let x represent number of students who took both Physics and Lit.

$\frac{x}{40}\times\frac{x-1}{39}=\frac{1}{10}$ --- [M1]

$10x(x-1)=40\times39$

$x^2-x-156=0$

$(x-13)(x+12)=0$ --- [M1]

$x=13$ or $x=-12$ (rej)

Note: Award full credit if students managed to obtain the first column correctly by trial and error, with relevant workings provided.
i.e.

$13+7=20$

By trial and error,

$\frac{13}{40}\times\frac{12}{39}=\frac{1}{10}$

Therefore, there are 13 students taking Physics and Literature.

7 students take Physics but not Literature.

(b)(ii)

$\frac{18}{40}\times\frac{22}{39}\times2$ --- [M1, allow ecf]

$=\frac{33}{65}$ --- [A1]

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	Solution/ Mark Scheme
5	**(a)**

$\frac{2}{3}\pi(2r)^3 = \frac{1}{3}\pi(2r)^2 h$ --- [M1, M1]

$\frac{2}{3}\pi(8r^3) = \frac{1}{3}\pi(4r^2)h$

$16r^3 = 4r^2 h$

$h = \frac{16r^3}{4r^2}$

$h = 4r$ --- [A1]

M1: applying formula to find vol of hemisphere correctly.

M1: applying formula to find vol of cone correctly.

(b)

$\frac{2}{3}\pi(2r)^3 = 450$ --- [M1]

$\frac{16}{3}\pi r^3 = 450$

$r^3 = \frac{450\times 3}{16\pi}$

$r = \sqrt[3]{\frac{450\times 3}{16\pi}}$

$r = 2.9947$ (5 s.f.) --- [A1]

Total surface area: $2\pi(R)^2 + \pi(R)l$, where $R = 2r$

$l = \sqrt{R^2 + h^2}$

$= \sqrt{(2r)^2 + (4r)^2}$ --- [M1]

$= \sqrt{20r^2}$

$= \sqrt{20(2.9947)^2}$

$= 13.392$

Alternatively

(radius) $2\times 2.9947 = 5.9894$

(height) $4\times 2.9947 = 11.9788$

$l = \sqrt{5.9894^2 + 11.9788^2}$ --- [M1]

$= 13.392$

Total Surface area: $2\pi(2\times 2.9947)^2 + \pi(2\times 2.9947)(13.392)$ --- [M1]

$= 477.38$ cm^3 (5 s.f.)

≈ 477 cm^3 --- [A1]

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	Solution/ Mark Scheme
6	**(a)**

$\angle PQS = \angle SRP$ (angles in the same segment)

$\angle OSP = \angle OPS$ (base angles, isos. triangle)
$\angle QSP = \angle QSO + \angle OSP$
$= \angle RPO + \angle OPS$
$= \angle RPS$

PS is the common side.

M1 for any two correct;

M2 for all three correct

By AAS test, triangles SQP and PRS are congruent. --- [A1]

*max 1 mark is deducted directly from the question for any wrong reason given.

(b)

$\angle POS = 64° \times 2$ ($\angle$ at centre = $2\angle$ at circumference)
$= 128°$

$\angle OPT = \angle OST = 90°$ (tangent perpendicular to radius)

$\angle PTS = 360° - 90° - 90° - 128°$ --- [M1]
$= 52°$

$\angle PTS + \angle PRS = 64° + 52° = 116° \ (\neq 180°)$

By property of angles in opposite segment, since $\angle PTS + \angle PRS \neq 180°$, we cannot draw a circle passing through P, R, S and T. [A1]

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(c)(i)

$$\angle OPS = \frac{180° - 128°}{2} \text{ (base angle, isos. triangle)}$$
$$= 26°$$

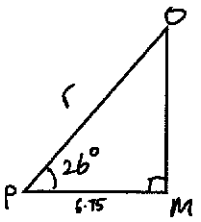
$$\frac{r}{\sin 26°} = \frac{13.5}{\sin 128°} \text{ --- [M1]}$$
$$r = \frac{13.5}{\sin 128°} \times \sin 26°$$
$$= 7.5100 \text{ (5 s.f.)}$$
$$\approx 7.51 \text{ (3.s.f) [shown] --- [A1]}$$

Alternative #1

$$13.5^2 = r^2 + r^2 - 2r^2 \cos 128° \text{ --- [M1]}$$
$$13.5^2 = 2r^2 - 2r^2 \cos 128°$$
$$13.5^2 = r^2(2 - 2\cos 128°)$$
$$r^2 = \frac{13.5^2}{(2 - 2\cos 128°)}$$
$$r = 7.5100$$
$$\approx 7.51 \text{ (3 s.f.) (shown)} \quad \text{[A1]}$$

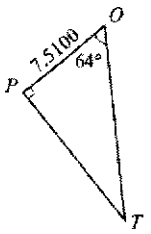
Alternative #2

$$\cos 26° = \frac{6.75}{r} \text{ --- [M1]}$$
$$r = \frac{6.75}{\cos 26°}$$
$$\approx 7.51 \text{ (3 s.f.) (shown)} \quad \text{[A1]}$$



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(c)(ii)



$\tan 64° = \dfrac{PT}{7.5100}$ --- [M1]

$PT = 7.5100 \tan 64°$

$PT = 15.397$

Method 1

Area of $OPTS$: $\dfrac{1}{2} \times 15.397 \times 7.5100 \times 2$ --- [M1, allow ecf]

$= 115.63 \text{ cm}^2$

Area of major sector $OPQRS$: $\dfrac{232}{360} \times \pi \times 7.5100^2$ --- [M1]

$= 114.18 \text{ cm}^2$

Total area: $115.63 \text{ cm}^2 + 114.18 \text{ cm}^2 = 229.81 \text{ cm}^2$

$\approx 230 \text{ cm}^2$ (3 s.f.) --- [A1]

Method 2

Area of $OPTS$: Area of triangle POS + Area of triangle PTS

$= \dfrac{1}{2} \times 7.5100^2 \times \sin 128° + \dfrac{1}{2} \times 15.397^2 \times \sin 52°$ --- [M1, allow ecf]

$= 115.627 \text{ cm}^2$

Area of major sector $OPQRS$: $\dfrac{232}{360} \times \pi \times 7.5100^2$ --- [M1]

$= 114.18 \text{ cm}^2$

Total area: $115.627 \text{ cm}^2 + 114.18 \text{ cm}^2 = 229.807 \text{ cm}^2$

$\approx 230 \text{ cm}^2$ (3 s.f.) --- [A1]

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Method 3

[M1]: refer to method 1 or 2 on how to find Area of OPTS

Area of PST $\triangledown$:

$$115.63 - \underbrace{\left(\frac{128°}{360°} \times \pi \times 7.5100^2\right)}_{[M1]}$$
$$= 52.631$$

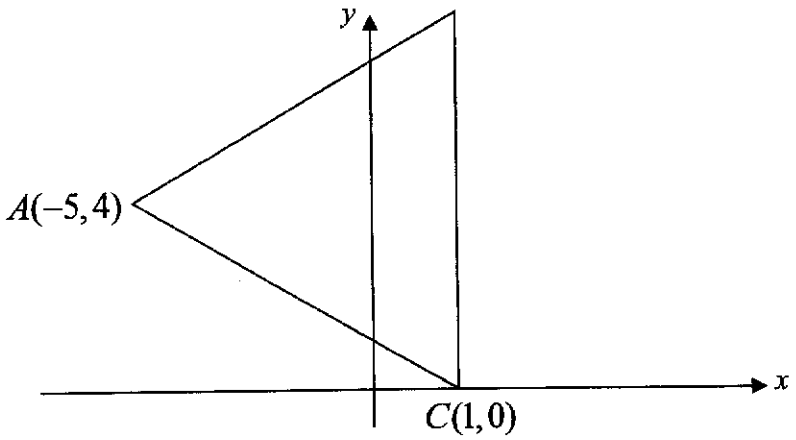
Shaded Area: Area of Circle + Area of PST

$$= \pi \times 7.5100^2 + 52.631$$
$$= 229.817 \text{ cm}^2 \approx 230 \text{ cm}^2 \text{ (3 s.f.)} \text{ --- [A1]}$$

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Solution/ Mark Scheme

7 **(a)**



Method 1:

$-5+3k=1$ --- [M1]

$3k=6$

$k=2$

$\therefore B(1,12)$ --- [M1]

$C(1,0)$

Method 2:

$\overrightarrow{OA}=\begin{pmatrix}-5\\4\end{pmatrix}$

Let coordinates of B be $(1,b)$

$\overrightarrow{OB}=\begin{pmatrix}1\\b\end{pmatrix}$

$\overrightarrow{AB}=\overrightarrow{OB}-\overrightarrow{OA}$

$\begin{pmatrix}3k\\4k\end{pmatrix}=\begin{pmatrix}1\\b\end{pmatrix}-\begin{pmatrix}-5\\4\end{pmatrix}$

$\begin{pmatrix}3k\\4k\end{pmatrix}=\begin{pmatrix}6\\b-4\end{pmatrix}$

$3k=6$ --- [M1]

$k=2$

$b-4=4(2)$

$b=12$

$B(1,12)$ --- [M1]

Area of triangle $ABC:\frac{1}{2}\times 6\times 12$ --- [M1]

$=36$ units^2 --- [A1]

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(b)(i)(a)

Method 1	**Method 2**
$\overrightarrow{BA} = \overrightarrow{OA} - \overrightarrow{OB}$ $= \mathbf{a} - \mathbf{b}$ $\overrightarrow{BX} = \frac{1}{2}(\mathbf{a} - \mathbf{b})$ --- [M1] $\overrightarrow{OX} = \overrightarrow{OB} + \overrightarrow{BX}$ $= \mathbf{b} + \frac{1}{2}(\mathbf{a} - \mathbf{b})$ $= \frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{b}$ --- [A1]	$\overrightarrow{BA} = \overrightarrow{OA} - \overrightarrow{OB}$ $= \mathbf{a} - \mathbf{b}$ $\overrightarrow{AX} = -\frac{1}{2}(-\mathbf{b} + \mathbf{a})$ --- [M1] $= \frac{1}{2}\mathbf{b} - \frac{1}{2}\mathbf{a}$ $\overrightarrow{OX} = \overrightarrow{OA} + \overrightarrow{AX}$ $= \mathbf{a} - \mathbf{b} + \frac{1}{2}\mathbf{b} - \frac{1}{2}\mathbf{a}$ $= \frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{b}$ --- [A1]

(b)(i)(b)

$\overrightarrow{OD} = 3 \times \overrightarrow{OA}$
$= 3\mathbf{a}$ --- [M1]

$\overrightarrow{OY} = \overrightarrow{OD} + \overrightarrow{DY}$
$= 3\mathbf{a} - (2\mathbf{a} - \mathbf{b})$
$= \mathbf{a} + \mathbf{b}$ --- [A1]

(b)(ii)

1. O, X and Y are collinear. --- [B1]

2. $OX = \frac{1}{2}OY$ or X is the midpoint of OY. --- [B1]

Note: Students are awarded the above only if both answers in (b)(i) are correct. Otherwise, no mark is awarded even if they somehow, were able to make the correct claims.

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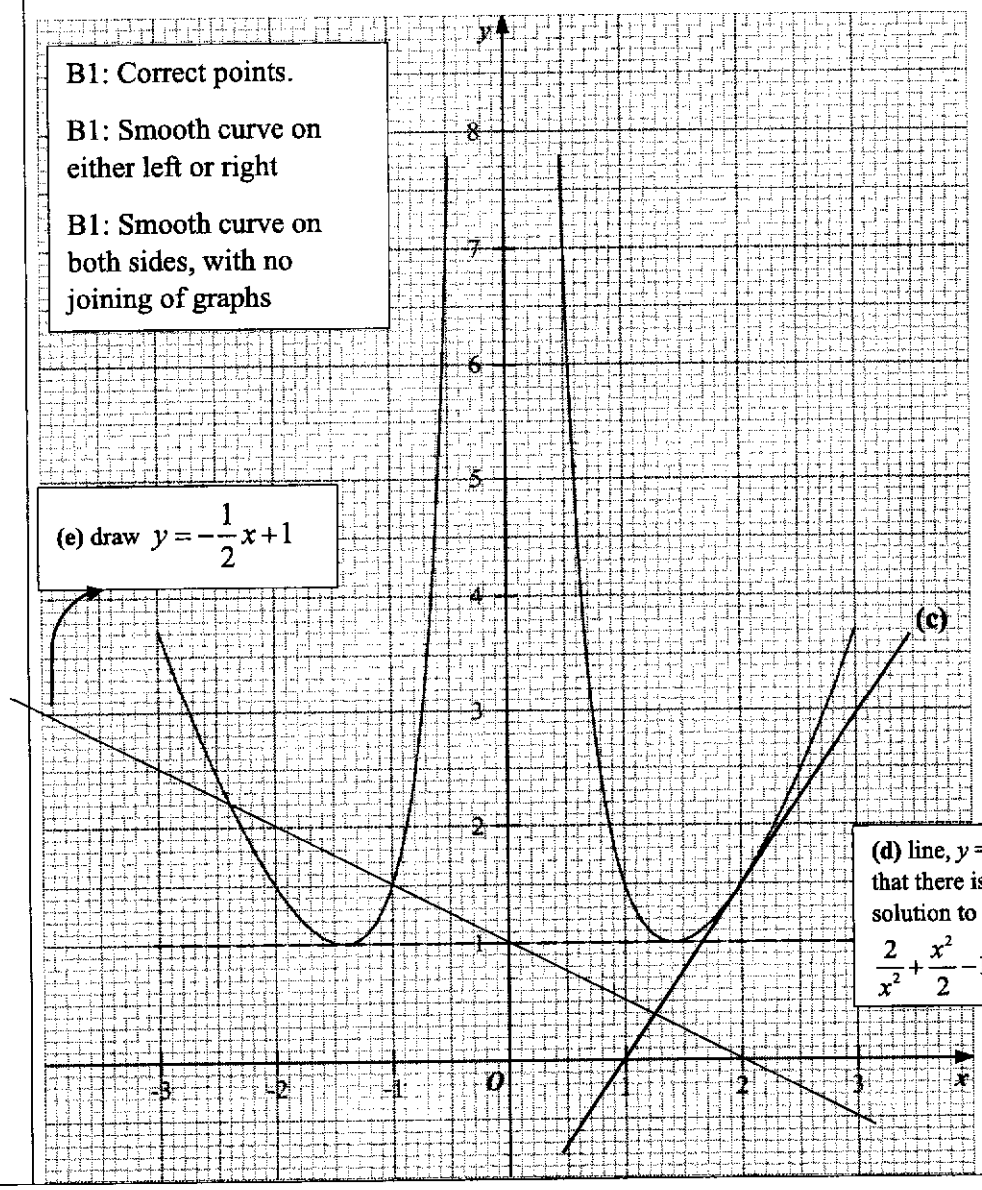
Solution/ Mark Scheme

8 **(a)**

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

B1 for both correct.

(b)



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(c)

M1: Drawing tangent line to the curve at point (2, 1.5)

$\frac{3-0}{3-1}=1.5$

Gradient: accept 1.3 to 1.7 --- [A1]

(d)

$k = 0.9/\ 0.95/\ 1$ --- [B1: accept either one]

(e)

$x^4+x^3-4x^2+4=0$

Divide throughout by x^2

$x^2+x-4+\frac{4}{x^2}=0$

$x^2-4+\frac{4}{x^2}=-x$

Divide throughout by 2

$\frac{1}{2}x^2-2+\frac{2}{x^2}=-\frac{1}{2}x$

$\frac{2}{x^2}+\frac{x^2}{2}-1=-\frac{1}{2}x+1$ --- [M1 for expression on RHS]

[M1: drawing linear graph $y=-\frac{1}{2}x+1$]

$x=-1.1/-1.05/-1/-0.95/-0.9$ or --- [A1]

$-2.3/-2.35/-2.4/2.45/-2.5$ --- [A1]

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	Solution/ Mark Scheme
9	**(a)** $\$[250+0.375\times(1400-1000)]\times 1.564$ $=\$625.60$ — [B1]
	(b) $\$\dfrac{2.3+2.7+2.7+\ldots+2.5+2.7}{12}$ — [M1] $=\$2.57$ (2 d.p.) — [A1]

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Important note: There are two main approach: students compare prices which involves the calculation of either mean monthly fuel cost **OR** using the most expensive fuel cost of the year. Students need to be consistent in their comparison, i.e. award final A1 mark only if students compare costs using average monthly fuel with average monthly fuel or most exp. cost with most exp. cost.

(c) **Method 1: Using the mean fuel price and annual approach**

Ponda Fleet	**Toyoyo Joah**	
Average monthly cost of Petrol: $\$\frac{3.4+3.6+3.5+...+3.8}{12}$ --- [M1] $=\$3.525$		
Annual fuel cost: $\$3.525\times\frac{11000}{25}$ $=\$1551$	Annual fuel cost: $\$2.57\times\frac{11000}{16}$ $=\$1766.875$	--- [M1 for either correct]
Road Tax: $\$[250+0.375\times(1500-1000)]\times1.564$ $=\$684.25$	Road Tax: $\$[475+0.75\times(2000-1600)]\times1.564$ $=\$1212.10$	--- [M1 for either correct]
Total interest: $\frac{4}{100}\times\$172000\times7=\$48160$	Total interest: $\frac{4}{100}\times\$160000\times7=\$44800$	--- [M1 for either correct]
Annual cost for paying car: $\frac{\$172000+\$48160}{7}=\$31451.43$ (2 d.p)	Annual cost for paying car: $\frac{\$160000+\$\$44800}{7}=\$29257.14$ (2 d.p)	
Total cost for driving Ponda Fleet: $\$1551+\$684.25+\$31451.43=\$33686.68$ --- [A1]	Total cost for driving Ponda Fleet: $\$\$1766.875+\$1212.10+\$\$29257.14=\$32236.12$ (2.d.p.) --- [A1]	

Ean should get the Toyoyo Joah as it can accommodate his whole family. The total annual cost of $32 236.12 is lower, as compared to the other car which can also accommodate the whole family, the Ponda Fleet. The Ponda Fleet would costs Ean $33 686.68 annually. --- [A1]

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(c) **Method 2: Using the mean fuel price and 7-year approach**

Ponda Fleet	**Toyoyo Joah**	
Average monthly cost of Petrol: $\$\frac{3.4+3.6+3.5+...+3.8}{12}$ --- [M1] $=\$3.525$		
Annual fuel cost: $\$3.525\times\frac{11000}{25}$ $=\$1551$	Annual fuel cost: $\$2.57\times\frac{11000}{16}$ $=\$1766.875$	--- [M1 for either correct]
Road Tax: $\$[250+0.375\times(1500-1000)]\times1.564$ $=\$684.25$	Road Tax: $\$[475+0.75\times(2000-1600)]\times1.564$ $=\$1212.10$	--- [M1 for either correct]
Total interest: $\frac{4}{100}\times\$172000\times7=\$48160$	Total interest: $\frac{4}{100}\times\$160000\times7=\$44800$	--- [M1 for either correct]
Total cost for driving Ponda Fleet: $7(\$1551+\$684.25)+\$48160+\$172000=\$235806.75$ [A1]	Total cost for driving Ponda Fleet: $7(\$1766.875+\$1212.10)+\$16000+\$44800=\$225652.83$ (2.d.p.) [A1]	

Ean should get the Toyoyo Joah as it can accommodate his whole family. The total cost at the end of 7 years, $225 652.83 is lower, as compared to the other car which can also accommodate the whole family, the Ponda Fleet. The Ponda Fleet would costs Ean $235 806.75 at the end of 7 years. --- [A1]

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(c) **Method 3: Using the most expensive (worst case) fuel price and annual approach**

Ponda Fleet	**Toyoyo Joah**	
Most expensive cost per month: \$3.80/*l*	Most expensive cost per month: \$2.70/*l*	---[M1 for either correct]
Annual fuel cost: $\$3.80\times\frac{11000}{25}$ $=\$1672$	Annual fuel cost: $\$2.70\times\frac{11000}{16}$ $=\$1856.25$	--- [M1 for either correct]
Road Tax: $\$[250+0.375\times(1500-1000)]\times1.564$ $=\$684.25$	Road Tax: $\$[475+0.75\times(2000-1600)]\times1.564$ $=\$1212.10$	--- [M1 for either correct]
Total interest: $\frac{4}{100}\times\$172000\times7=\$48160$	Total interest: $\frac{4}{100}\times\$160000\times7=\$44800$	--- [M1 for either correct]
Annual cost for paying car: $\frac{\$172000+\$48160}{7}=\$31451.43$ (2 d.p)	Annual cost for paying car: $\frac{\$160000+\$\$44800}{7}=\$29257.14$ (2 d.p)	
Total cost for driving Ponda Fleet: \$1672 + \$684.25 + \$31451.43 = \$33807.68 --- [A1]	Total cost for driving Ponda Fleet: \$1856.25 + \$1212.10 + \$\$29257.14 = \$32325.49 (2.d.p.) --- [A1]	

Ean should get the Toyoyo Joah as it can accommodate his whole family. The total annual cost of \$32 325.49 is lower, as compared to the other car which can also accommodate the whole family, the Ponda Fleet. The Ponda Fleet would costs Ean \$33 807.68 annually. --- [A1]

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(c) **Method 4: Using the most expensive (worst case) fuel price and 7-year approach**

Ponda Fleet	**Toyoyo Joah**	
Most expensive cost per month: \$3.80/*l*	Most expensive cost per month: \$2.70/*l*	---[M1 for either correct]
Annual fuel cost: $\$3.80\times\frac{11000}{25}$ $=\$1672$	Annual fuel cost: $\$2.70\times\frac{11000}{16}$ $=\$1856.25$	--- [M1 for either correct]
Road Tax: $\$[250+0.375\times(1500-1000)]\times1.564$ $=\$684.25$	Road Tax: $\$[475+0.75\times(2000-1600)]\times1.564$ $=\$1212.10$	--- [M1 for either correct]
Total interest: $\frac{4}{100}\times\$172000\times7=\$48160$	Total interest: $\frac{4}{100}\times\$160000\times7=\$44800$	--- [M1 for either correct]
Total cost for driving Ponda Fleet: $7(\$1672+\$684.25)+\$48160+\$172000=\$236653.75$ [A1]	Total cost for driving Ponda Fleet: $7(\$1856.25+\$1212.10)+\$44800+\$160000=\$226278.45$ [A1]	

Ean should get the Toyoyo Joah as it can accommodate his whole family. The total cost of \$226 278.45 at the end of 7 years is lower, as compared to the other car which can also accommodate the whole family, the Ponda Fleet. The Ponda Fleet would costs Ean \$236 653.75 at the end of 7 years. --- [A1]

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