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TAMPINES SECONDARY SCHOOL

Secondary Four Express / Five Normal Academic
Preliminary Examination 2024

NAME

CLASS

REGISTER NUMBER

MATHEMATICS **4052/01**

Paper 1 **22 August 2024**

2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

For Examiner's Use

Write your name, class and register number on all the work you hand in.
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.

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 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, unless the question requires the answer in terms of π.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is **90**.

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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 = $4\pi r^2$

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

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

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

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

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

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

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Answer **all** the questions.

1 Find the largest prime number that satisfies the inequality $\frac{3x-8}{2} < 28$.

Answer ..... [2]

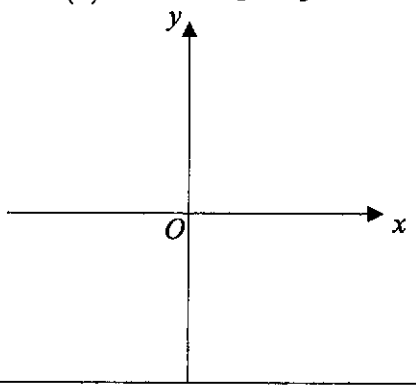
2 Expand and simplify $a-3(a-5b)$.

Answer ..... [1]

3 Factorise $4x^6-100y^2$ completely.

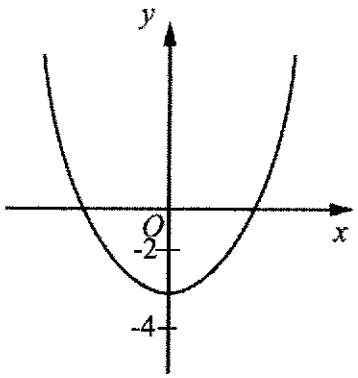
Answer ..... [2]

4 **(a)** Sketch the graph of $y=2(3)^x$, indicating the points of intersection between the axes, if any.



[1]

(b) State a possible equation for the graph shown below.



Answer ..... [1]

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5 At the end of 2023 there were 27000 rhinos living in the wild.
The number of rhinos is expected to increase exponentially by 3% each year.

Calculate the number of rhinos expected to be living in the wild at the end of 2027.
Give your answer correct to the nearest ten thousand.

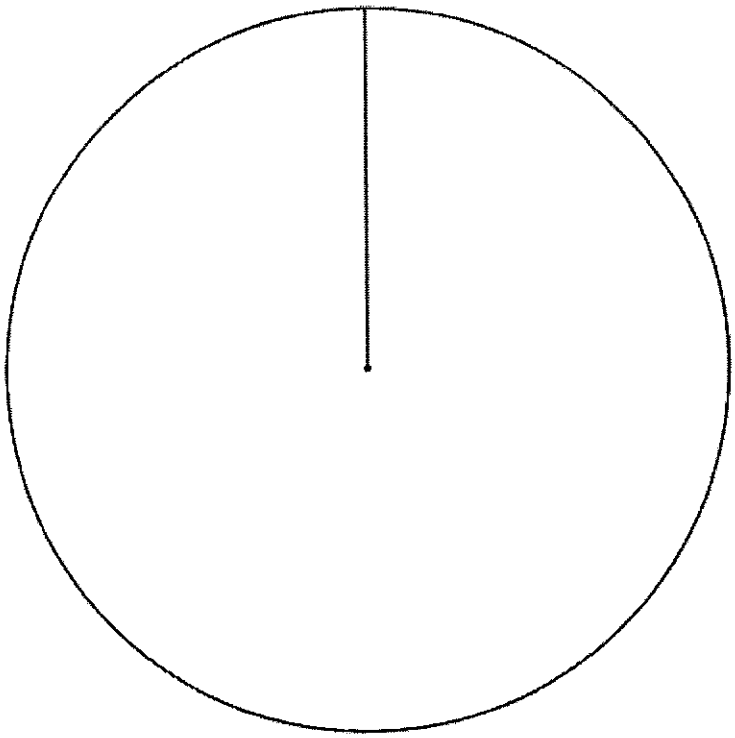
Answer ..... [2]

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6 The table below shows the favourite language that each of 80 students studies.

Language	Frequency
French	20
Japanese	42
Thai	18

Complete the pie chart to show this information.

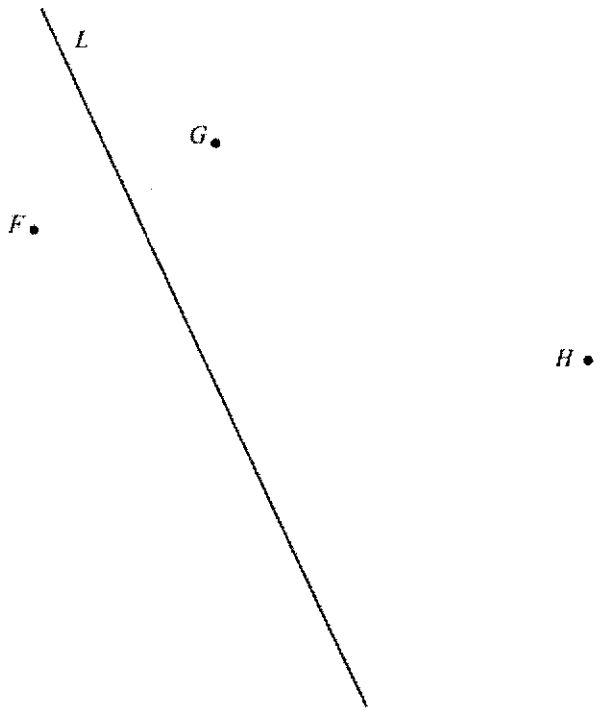


[2]

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7 **Use a ruler and compasses only** for this question.
You must show all your construction arcs.

Line L is the perpendicular bisector of FG.
Construct a circle that passes through the points F, G and H. [2]



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8 **(a)** By using prime factorization, explain why 2420 is not a perfect cube.

Answer .....

.....

..... [2]

(b) When written as a product of its prime factors, the lowest common multiple of two numbers is 2420 and the highest common factor of these two numbers is 110.
Given that **neither of these two numbers is 2420**, find the value of these two numbers.

Answer ..... and ..... [2]

---

9 **(a)** Simplify $\left(\frac{27x^{15}}{8y^{12}}\right)^{-\frac{1}{3}}$.

Answer ..... [2]

(b) (i) Factorize $4xy-2+y-8x$ completely.

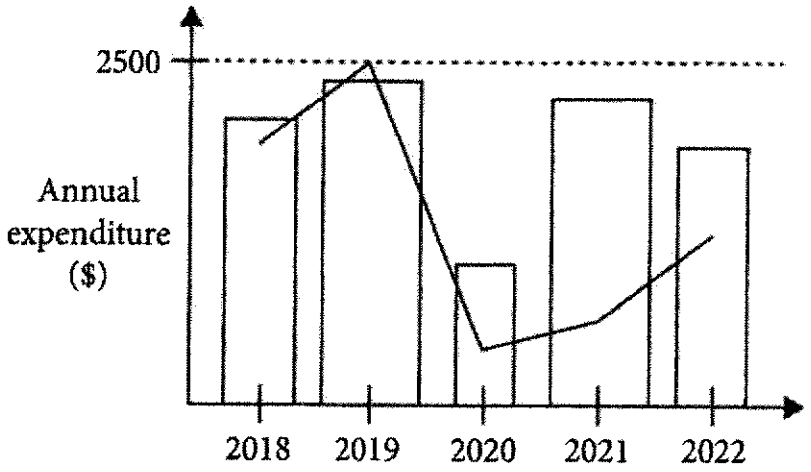
Answer ..... [2]

(ii) Hence solve the equation $7^{4xy-2+y-8x}=1$.

Answer $x=$ ....., $y=$ ..... [1]

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10 Susan draws the diagram below to show her annual expenditure on flight tickets and hotel stays.
The vertical bars represent the amounts spent on hotel stays.
The line graph represents the amount spent on flight tickets.



(a) State one aspect of the graph that may be misleading and how this may lead to a misinterpretation of the annual amount spent on hotel stays.

Answer .....

.....

.....

..... [2]

(b) Susan claims that, the years when she spends more on flight tickets corresponds to when she spends more on hotel stays.

Does the chart support her claim?
Justify your answer with reference to the chart.

Answer The chart support / does not support her claim because .....

.....

.....

..... [1]

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11 **(a)** The following shows two sets.

$A = \{4, 8, 12, 16, 20, 24\}$ $B = \{8, 16, 24\}$

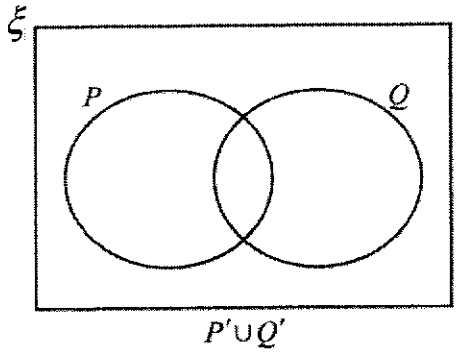
Use the following set notations to complete this statement.

$\subset$ $\not\subset$ $\in$ $\notin$ ϕ $\cup$ $\cap$

(i) B ..... A [1]

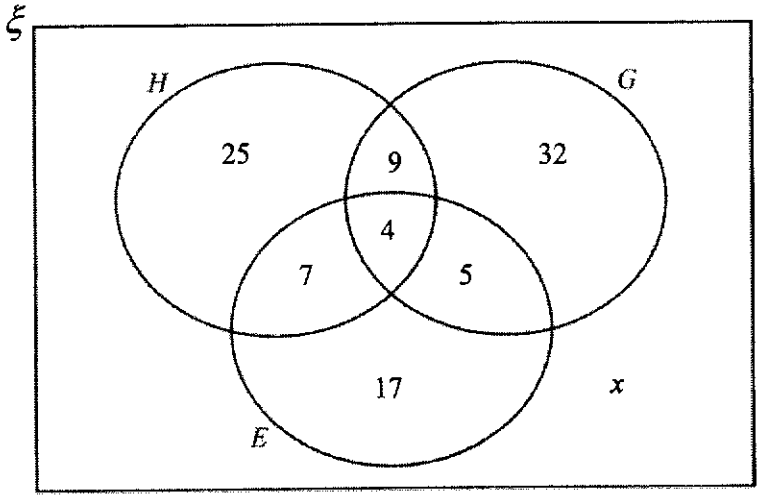
(ii) 22 ..... A [1]

(b) Shade the given set on the Venn diagram below.



$P' \cup Q'$ [1]

(c) There are 120 students in a group.
The Venn diagram below shows the number of students who study History (H), Geography (G) and Economics (E).



(i) Find the value of x and state what this value represents.

Answer $x =$ ..... and it represents .....

..... [1]

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(ii) Two of the students who study Economics are chosen at random.

Find, as a fraction in its simplest form, the probability that one of these students also studies Geography but not History and the other student also studies History but not Geography.

Answer ..... [2]

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12 Find five positive integers that satisfy all four of the following conditions.

(1) Mode = 5
(2) Median = 5
(3) Mean = 6
(4) Range = 7

Answer ....., ..., ..., ..., ... [1]

---

13 The following shows a list of ingredients for a recipe for making shortbread biscuits.

Ingredients to make **25** biscuits
- 250 grams of flour
- 100 grams of sugar
- 175 grams of butter

(a) Write down the ratio of flour, sugar and butter in its simplest form.

Answer ..... : ..... : ..... [1]

(b) Raju is making shortbread biscuits for a party using this recipe.
She wants to make as many biscuits as possible.
She has 1.5 kg of flour, 0.5 kg of sugar and 1 kg of butter.
Calculate the maximum number of biscuits Raju can make.

Answer ..... [2]

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14 The expression $9-5x+x^2$ can be written in the form $p+(x-2.5)^2$.

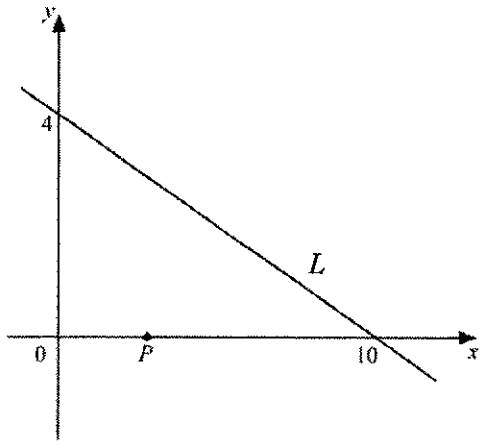
(a) Find the value of p.

Answer $p=$ ..... [1]

(b) Write down the equation of the line of symmetry of the graph $y=9-5x+x^2$.

Answer ..... [1]

15



The diagram above shows a straight line L. The line cuts the axes at (10, 0) and (0, 4).

(a) Find the equation of line L.

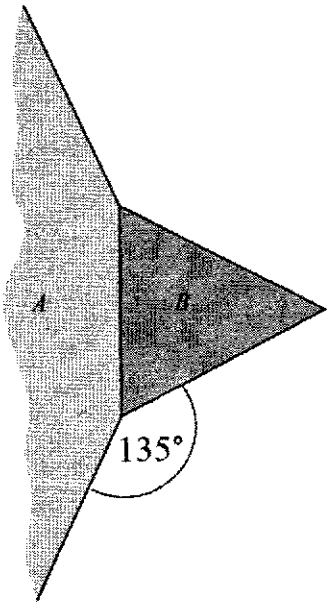
Answer ..... [2]

(b) The point P has coordinates (3, 0). Calculate the shortest distance from P to line L.

Answer ..... [3]

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16 The diagram shows part of the regular polygon A joining the equilateral triangle B.
Calculate the number of sides of polygon A.



Answer ..... [3]

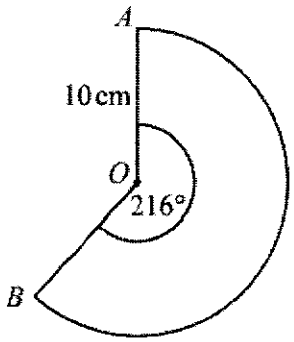
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17 P is inversely proportional to the square root of Q.
The **sum** of the values of P when $Q=9$ and when $Q=16$ is 21.
Find the value of Q when $P=100$.

Answer ..... [3]

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18



AOB is a sector of a circle, centre O. $OA = 10$ cm and the sector angle is 216°.

(a) Calculate the perimeter of this sector. Give your answer in terms of π.

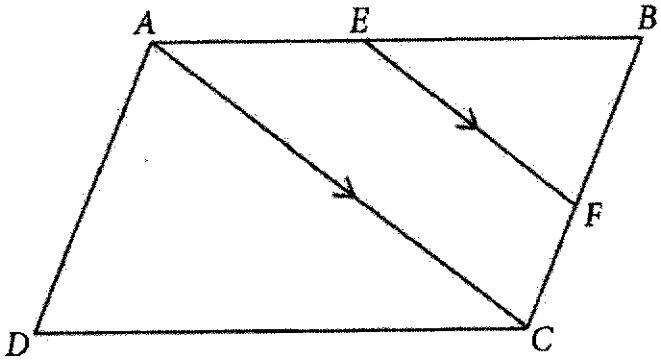
Answer .....cm [2]

(b) A cone is made from this sector by joining OA to OB.
Calculate the volume of the cone.

Answer .....cm^3 [4]

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19 $ABCD$ is a parallelogram. The points E and F lie on AB and BC respectively such that EF is parallel to AC.



(a) Identify two triangles and show that they are congruent. [2]

Answer

(b) Given that $AE = BE$, find the ratio of the area triangle BEF : area of trapezium $ACEF$.

Answer ..... : ..... [2]

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20 **(a)** The nth term of a sequence is given by $2n^2+4$.

(i) Write down the first 5 terms.

Answer ....., ..., ..., ..., ... [1]

(ii) Explain why it is not possible for a term in this sequence to be an odd number.

Answer .....

..... [1]

(b) The first 5 terms of another sequence are -1 , 5, 15, 29, 47, ...

By comparing this sequence with your answer to **(a)**, write down the kth term.

Answer ..... [1]

---

21 Solve $\frac{4x+5}{x}=4+\frac{3}{x+2}$.

Answer $x=$ ..... [3]

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22 Two teams played 16 basketball matches.
Their scores are shown in the stem-and-leaf diagram.

Team A							Team B				
		1	1	0	0	3	6	6			
8	8	6	2	1	0	4	2	3	3	7	
	5	4	3	3	2	5	0	2	4	6	7
						6	1	6	8	9	
					9	7	3				

Key : 0 | 3 | 6 Means a score of 30 by Team A and a score of 36 by Team B

(a) Find the median score of Team A.

Answer ..... [1]

(b) Find the interquartile range of the scores of Team B.

Answer ..... [1]

(c) Use your answers to part **(a)** and **(b)** to make two comments comparing the scores of the two teams.

Answer

1.....

.....

.....

2.....

.....

..... [2]

(d) Explain why the mean may not be an appropriate average to use to summarise the scores of Team A.

Answer .....

..... [1]

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23 A bakery makes chicken pies (C), seafood pies (S) and vegetarian pies (V) every day.
The matrix **M** shows the number of pies of each type that are made each day.

$$\mathbf{M} = \begin{matrix} \\ \text{small} \\ \text{large} \end{matrix} \begin{matrix} \begin{matrix} \text{C} & \text{S} & \text{V} \end{matrix} \\ \begin{pmatrix} 80 & 60 & 20 \\ 70 & 40 & 40 \end{pmatrix} \end{matrix}$$

(a) Evaluate the matrix $\mathbf{P} = 7\mathbf{M}$.

Answer ..... [1]

(b) Each small pie costs \$1.25 to make.
Each large pie costs \$2.50 to make.
By representing these amounts in a 1×2 row matrix **N**, evaluate the matrix $\mathbf{T} = \mathbf{NP}$.

Answer [1]

(c) Explain what the third element in matrix **T** represents.

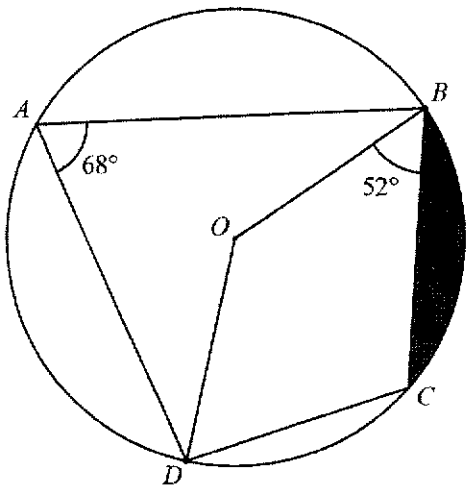
Answer ..... [1]

(d) One week, the bakery sold all the chicken pies and vegetarian pies, and $\frac{3}{5}$ of each size of the seafood pies that were made that week. The unsold pies were given to the staff of the bakery. Given that the bakery made a profit of 150% for each pie that it sells, calculate the total amount of profit that the bakery made that week.

Answer ..... [2]

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24



A, B, C and D are points on the circle, centre O.
Angle $BAD = 68°$ and angle $OBC = 52°$.

(a) Work out the angle ODC.
Give a reason for each step of your answer.

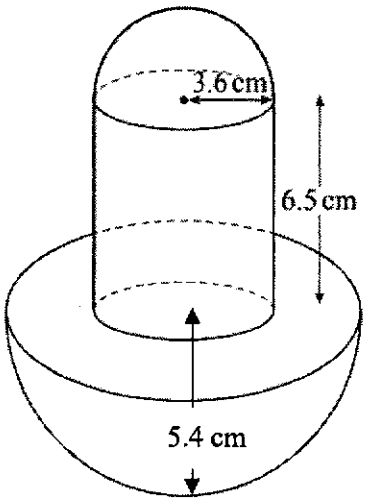
Answer ..... [3]

(b) Given that the length of $OB = 5$ cm. Calculate the area of the shaded segment BC.

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

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25



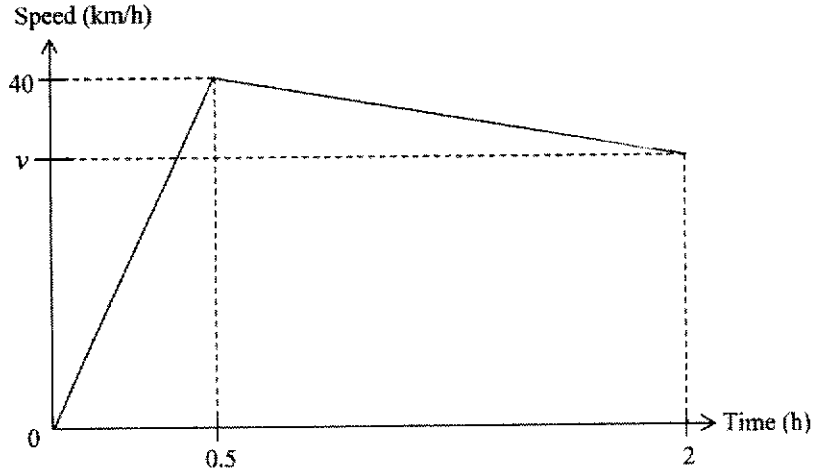
The diagram shows a solid formed by joining two hemispheres and a cylinder.
The radius of the small hemisphere and the radius of the cylinder are both 3.6 cm.
The length from the centre to the bottom of the large hemisphere is 5.4 cm.

Calculate the total surface area of the solid.

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

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26 The diagram shows the speed-time graph for Anne in the first 2 hours of a cycling race.

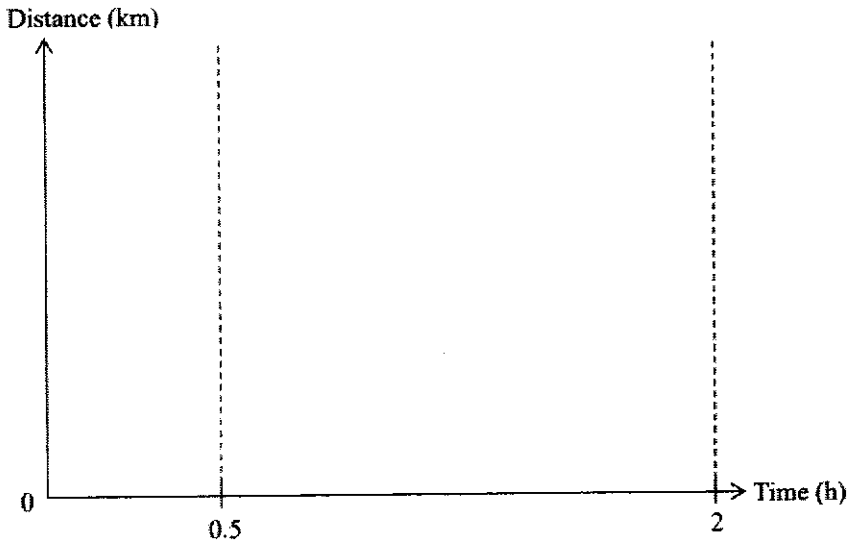


(a) The deceleration of Anne's journey after 0.5 hours is 6 km/h.
Find the value of v.

Answer $v =$ ..... **km/h** [2]

(b) The area under the speed-time graph represents the distance travelled.
Draw the distance-time graph for the first 2 hours of Anne's journey.

Answer



[2]

End of Paper

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TAMPINES SECONDARY SCHOOL

Secondary Four Express / Five Normal Academic
PRELIMINARY EXAMINATION 2024

NAME

CLASS | | | | **REGISTER NUMBER** | |

MATHEMATICS **4052/02**

Paper 2 **23 August 2024**

2 hours 15 minutes

Candidates answer on the Question Paper.

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	**Total**

READ THESE INSTRUCTIONS FIRST

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This document consists of **22** printed pages and **2** blank pages.

[Turn over

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Mathematical Formulae

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

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

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

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1 **(a)** Simplify $\frac{6(a+1)^3}{7b} \div \frac{9(a+1)}{28b}$.

Answer ..... [2]

(b) $x = a + \frac{bv^2}{k}$

(i) Find x when $a = 2$, $b = 3$, $v = -4$ and $k = 5$.

Answer $x =$ ..... [1]

(ii) Rearrange the formula to make v the subject.

Answer $v =$ ..... [3]

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(c) Solve the simultaneous equations.

$4x+7y=-23$
$6x-2y=3$

You must show your working.

Answer $x =$ .....

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

(d) Write as a single fraction in its simplest form $\dfrac{x^2}{(x+y)(x-3y)}-\dfrac{x-y}{x-3y}$.

Answer ..... [2]

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2 **(a)** Faiz invested \$25 000 in an account which paid simple interest.
At the end of 9 months, the value of the investment was \$26 500.
Calculate the interest rate per annum of the investment.

Answer ..... % [2]

(b) Jane exchanged 500 Singapore dollars (\$) into Thai baht (THB) when the exchange rate was \$1 = 26.77 THB. She travelled to Thailand and spent 10 600 THD.
On her return to Singapore, she exchanged the remaining Thai baht into dollars with the exchange rate \$1 = 26.88 THB.

Calculate the amount she received in dollars. Correct your answer to the nearest cent.

Answer \$..... [2]

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(c) The cash price of a furniture set was \$2700. Kim bought the set under a hire purchase scheme: 15% deposit and monthly instalments of \$68 for 36 months.

Calculate the amount of interest paid as a percentage of the cash price.

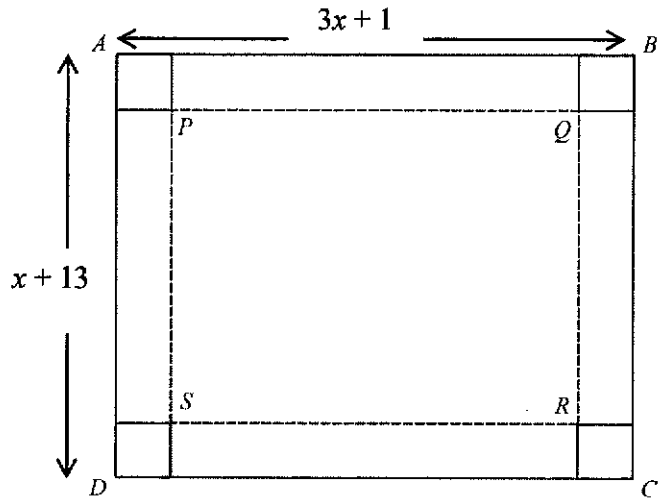
Answer ..... % [3]

(d) By selling an item at 25% discount off the marked price, a shopkeeper still makes 10% profit on his cost. If the cost price is \$180, calculate the marked price of the item.

Answer \$ ..... [3]

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3



The diagram shows a rectangular cardboard $ABCD$ with $AB = (3x+1)$ cm and $AD = (x+13)$ cm. A square of side 3 cm is cut from each corner. The remaining cardboard is then folded along the dotted lines to form an open rectangular box with base $PQRS$ and height 3 cm. The volume of the tray is 930 cm^3.

(a) Form an equation, in terms of x, to represent this information and show that it simplifies to $3x^2 + 16x - 345 = 0$.

[4]

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(b) Solve the equation $3x^2 + 16x - 345 = 0$.
Give your solutions correct to two decimal places.

Answer $x =$ ..... or $x =$ ..... [3]

(c) Find the length of the diagonal SQ.

Answer ..... cm [3]

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4 **(a)** A is the point (3, 7) and B is the point (13, – 8).

(i) Find $\left|\overrightarrow{AB}\right|$.

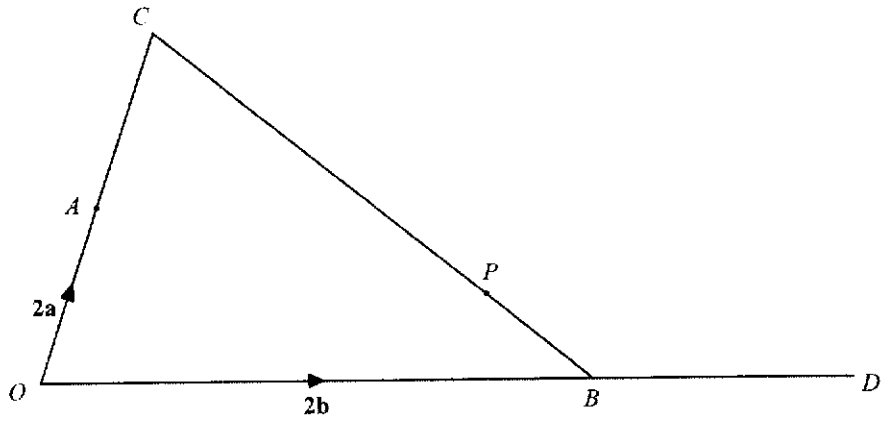
Answer ..... [2]

(ii) Given that $\overrightarrow{BA} = 2\overrightarrow{AP}$, find the coordinates of P.

Answer (..... , ...) [2]

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(b)



In triangle OCB, A is the midpoint of OC and P is the point on CB such that $CP = \frac{3}{4}CB$. The line OB produced to D such that $OB = 2\,BD$. $\overrightarrow{OA} = 2\,\mathbf{a}$ and $\overrightarrow{OB} = 2\,\mathbf{b}$.

(i) Express $\overrightarrow{CP}$ in terms of **a** and **b**, as simply as possible.

Answer ..... [2]

(ii) Express $\overrightarrow{AP}$ in terms of **a** and **b**, as simply as possible.

[1]

Answer .....

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(iii) Show that A, P and D lie on the same straight line.

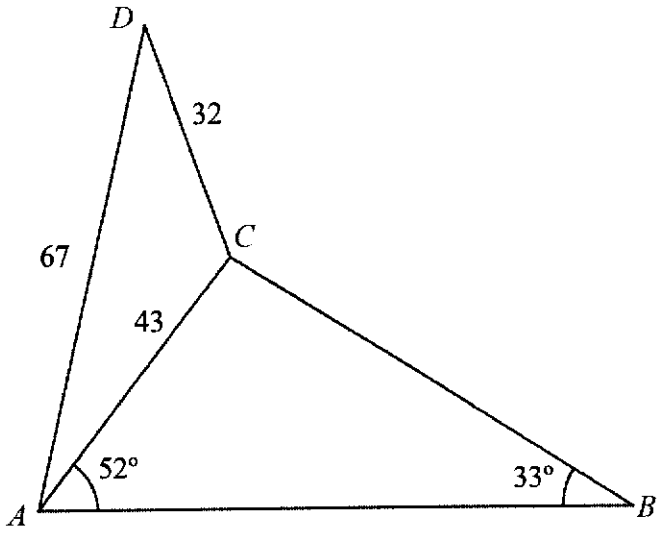
Answer ..... [3]

(iv) Find $\dfrac{\text{Area of } \Delta OCB}{\text{Area of } \Delta CPD}$.

Answer ..... [1]

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5



A, B, C and D are four points on level ground, with B due east of A.
$AC = 43$ m, $CD = 32$ m, $AD = 67$ m, angle $CAB = 52°$ and angle $ABC = 33°$.

(a) Calculate the bearing of B from C.

Answer ..... [2]

(b) Calculate AB.

Answer ..... *m* [2]

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(c) Calculate angle CDA.

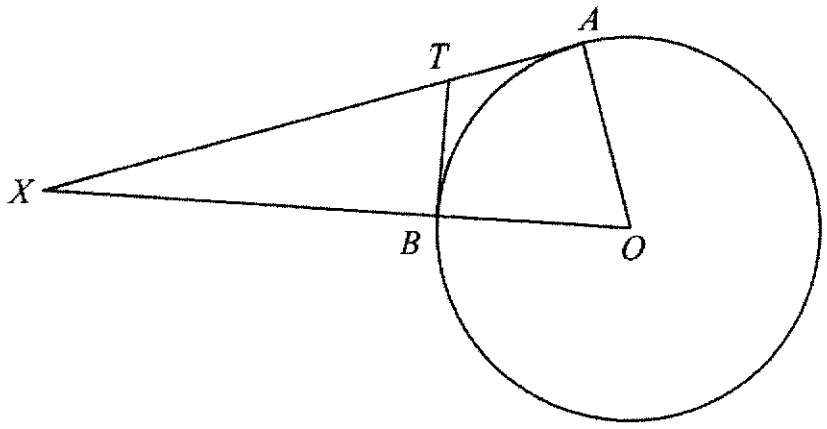
Answer ..... [3]

(d) A drone hovers 60 m vertically above D.
Find the angle of depression of A from the drone.

Answer ..... [2]

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6



The diagram shows a circle with centre O. TA and TB are tangents to the circle at A and B respectively. AT produced meets OB produced at X.

(a) Show that triangle OAX is similar to triangle TBX.
Give a reason for each statement you make.

[2]

(b) $XB = 12$ cm and $TX = 13$ cm.
(i) Find OA.

Answer ..... cm [3]

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(b) (ii) Calculate, as a fraction in its simplest form, the numerical value of the ratio

$$\frac{\text{area of triangle } TBX}{\text{area of quadrilateral } OATB}.$$

Answer ..... [2]

(iii) Calculate the reflex angle AOB in radians.

Answer ..... [3]

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7 **(a)** Complete the table of values for $y = 10 - x - \frac{16}{x}$.

x	1	2	3	4	5	6	7	8	9
y	-7	0	1.7		1.8	1.3	0.7	0	-0.8

[1]

(b) On the grid opposite, draw the graph of $y = 10 - x - \frac{16}{x}$ for $1 \le x \le 9$. [3]

(c) By drawing a tangent, find the gradient of the curve at $x = 3$.

Answer ..... [2]

(d) Use your graph to solve $9 - x - \frac{16}{x} = 0$.

Answer $x =$ ..... or $x =$ ..... [2]

(e) The straight line $y = mx - 1$ intersects the curve $y = 10 - x - \frac{16}{x}$ at two points.

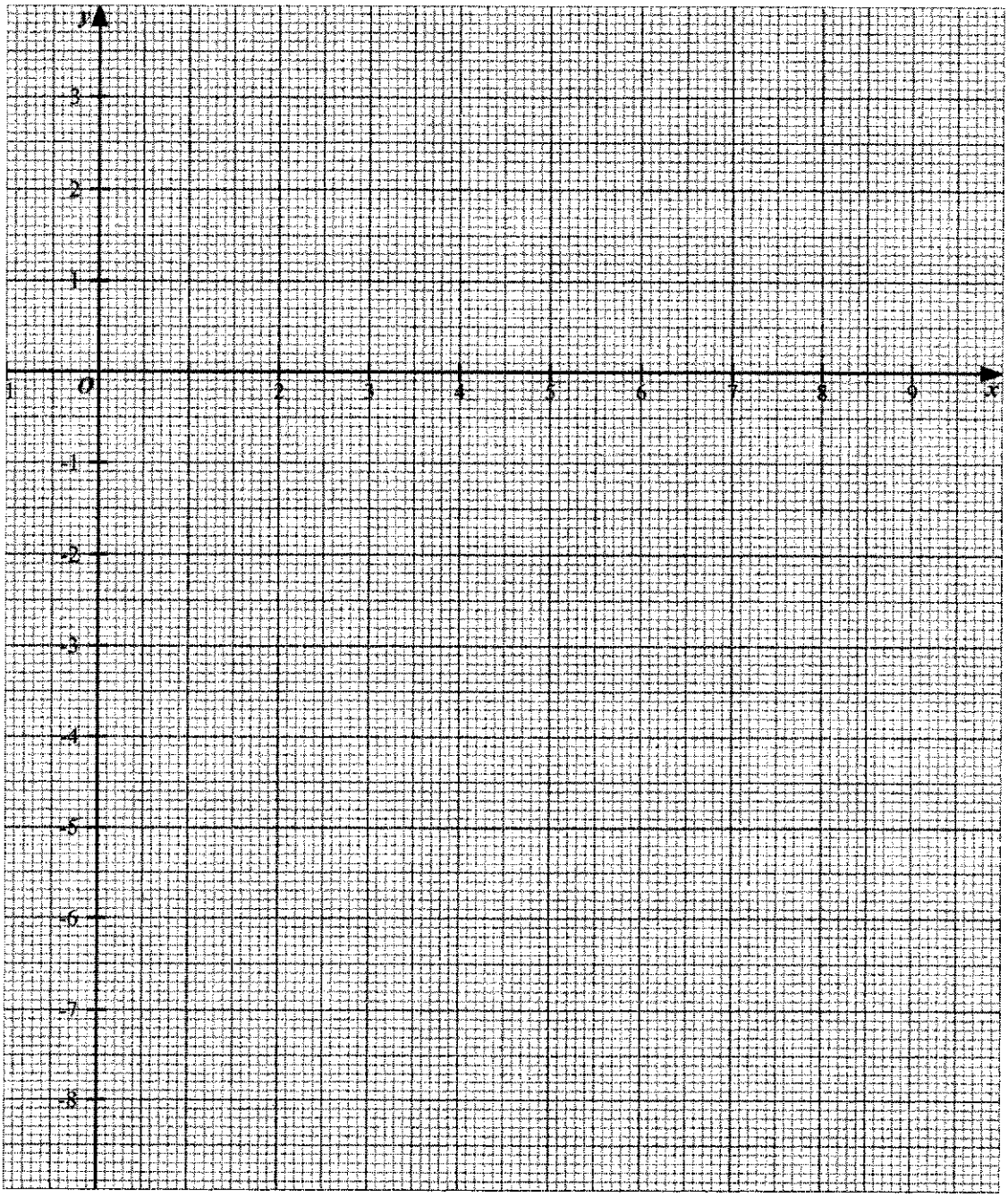
(i) Write down and simplify the equation, in terms of m, in the form $Ax^2 + Bx + 16 = 0$, which is satisfied by the values of x at the points of intersection.

Answer ..... [2]

(ii) If the values of y at the points of intersection are greater than or equal to zero, find the least value of m.

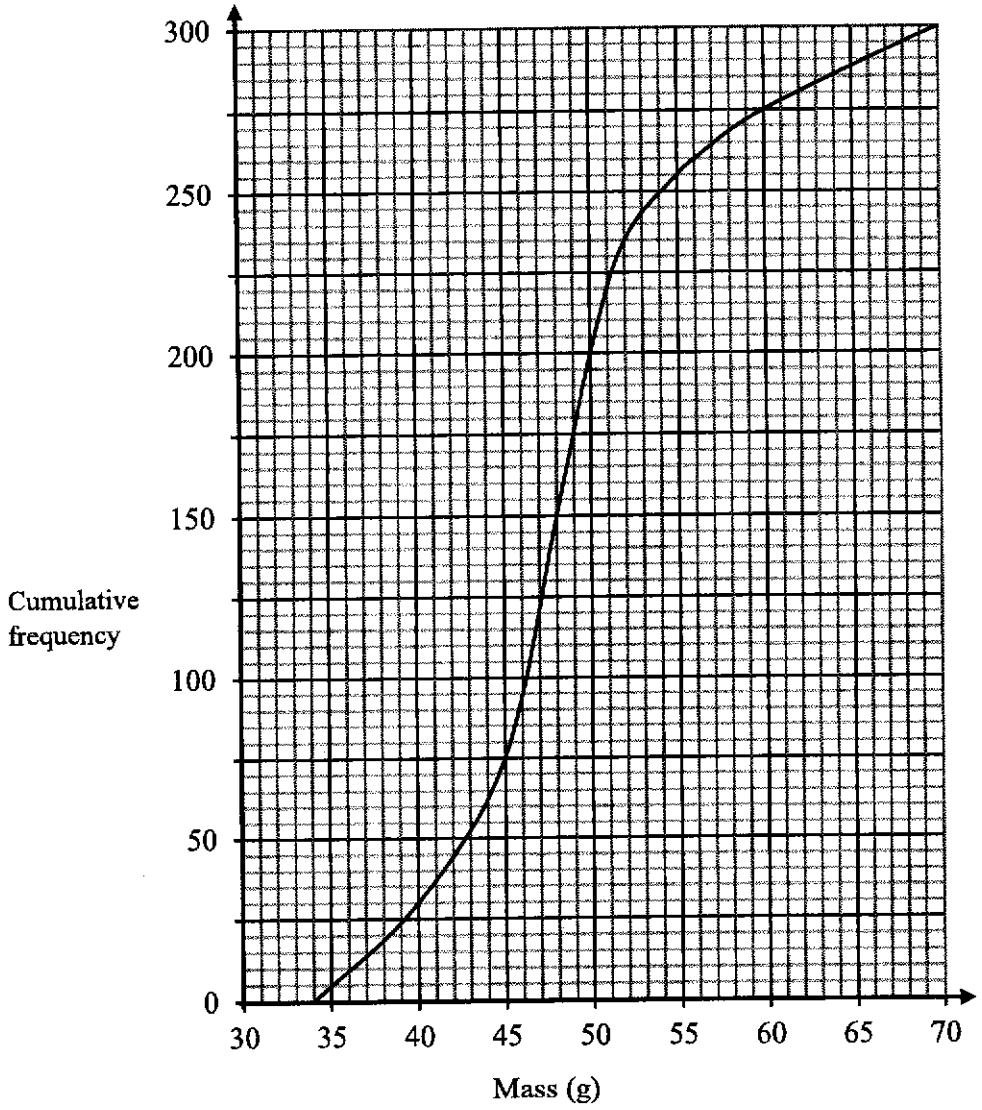
Answer $m =$ ..... [1]

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8 The masses, in grams, of a batch of 300 eggs are recorded.
The cumulative frequency curve shows the distribution of the masses.



(a) Use the curve to find

(i) the median mass of the eggs,

Answer ..... *g* [1]

(ii) the interquartile range,

Answer ..... *g* [2]

(iii) the 10^{th} percentile.

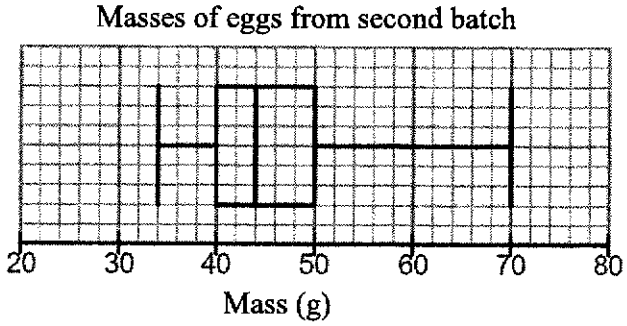
Answer ..... *g* [1]

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(b) An egg is classified as 'Medium' if its mass is greater than or equal to 50 g but less than 56 g. Two eggs are chosen at random.
Calculate the probability that both are 'Medium' eggs.

Answer ..... [2]

(c) The masses, in grams, of a **second** batch of 300 eggs are recorded and are represented by the box-and-whisker diagram below.



(i) Which batch of the eggs has more consistent mass?
Justify your answer using appropriate figures.

.....

..... [1]

(ii) The right whisker is longer than the left whisker.
Explain what this tells us about the distribution of the data set.

.....

..... [1]

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[Turn over for Question 9]

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9 The table shows the utility charges for Chen's family in July 2024.
It includes the charges for utilities such as electricity (in kilowatt-hours), gas (in kilowatt-hours), water (in cubic metres) and refuse removal. The charges for electricity, gas and water are dependent on their usage while refuse removal is a fixed amount.

	Usage	Rate ($)	Amount ($)	Total ($)
Electricity Services	289 kWh	***p***	86.09	86.09
Gas Services	11 kWh	0.2312	2.54	2.54
Water Services	8.5 Cu M	1.2900	10.97	
Waterborne Tax	8.5 Cu M	1.0000	8.50	
Water Conservation Tax	$10.97	50 %	5.49	24.96
Refuse Removal	1 Qty	9.00	9.00	9.00
Subtotal			122.59	122.59
GST	$122.59	9%	***r***	***r***
Current Charges: (inclusive of GST)				***s***

(a) Calculate the values of p, r and s.

Answer p = ...

r = ...

s = ... [3]

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(b) Chen considers installing an air-conditioner in his home at the beginning of August. He finds the following information from the National Environmental Agency (NEA) website on energy-efficient appliances and online electrical store.

Model of air-conditioner	Energy-efficient label*	Annual Energy Cost ($) **	
		For 6-hour usage/day	For 7-hour usage/day
A	√√√	792	923
B	√√√√	616	717
C	√√√√	789	894
D	√√√√√	552	643
E	√√√√√	594	688

* *more ticks (√) indicate more energy-efficient*

** *Annual Energy Cost is based on current rate in utility charge, excluding GST*

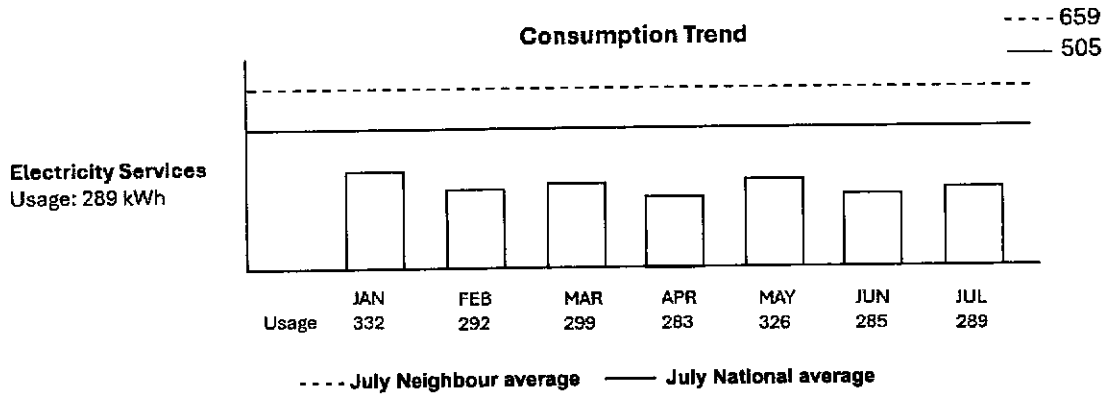
Example: If air-conditioner model A is used for 6 hours daily, the annual energy cost is $792.

Tips on Buying Energy-Efficient Air-Conditioner

- Choose an energy efficient air-conditioner with more ticks on the energy label.
- Choose models with lower Life Cycle Costs (LCC).
  LCC = Purchase Price + Annual Energy Cost × 7

Model of air-conditioner	A	B	C	D	E
Purchase Price $ (excluding GST)	1690	2749	1989	3499	3305

The chart shows Chen's electricity consumption trend:



Chen considers buying an air-conditioner with at least 4-ticks label, with low LCC and intends to use it for 6 hours each day. He expects an increase in electricity consumption in August, **in addition** to the 289 kWh recorded in July. However, he wants to keep his August total electricity consumption to be below July National average.

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Assuming the costs for gas, water services and refuse removal charge remain unchanged, suggest the model of air-conditioner he should opt for and estimate the August utility charge. Justify any decision you make and show your calculations clearly.

.....

..... [7]

End of Paper

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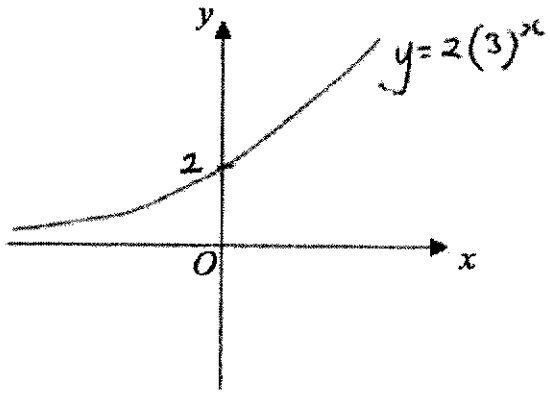
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Tampines Secondary School

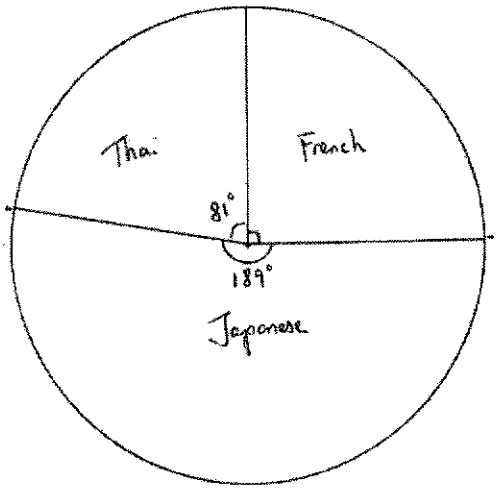
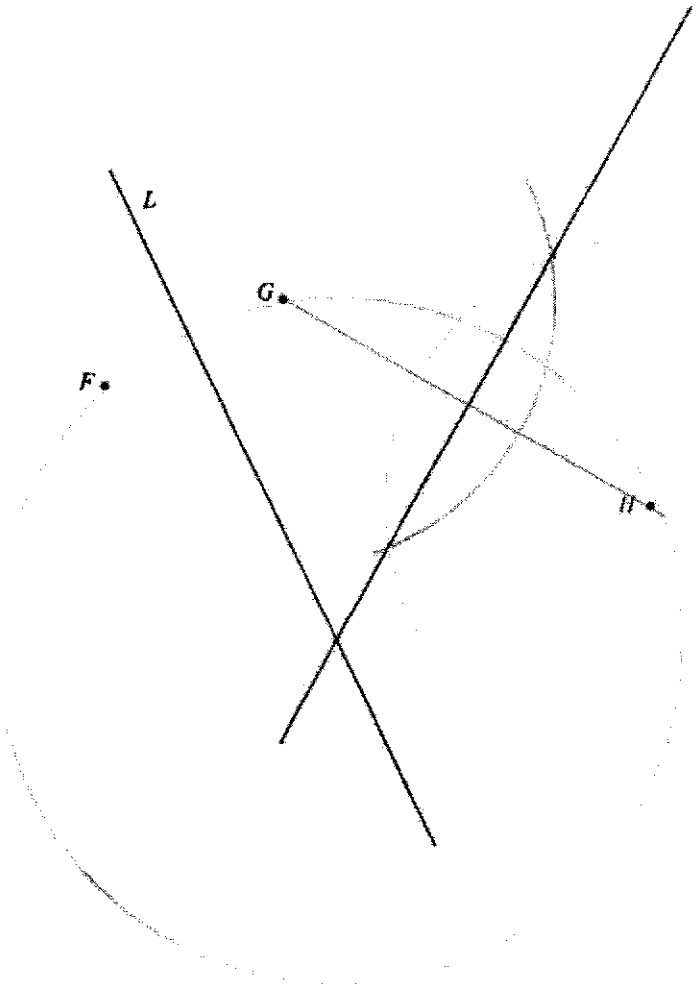
Sec 4E/5NA/4NA OOS Math Prelim Exam Paper 1 2024 Marking Scheme

Total Marks: 90

√ = follow through

No.	Answers	Marks
1	$3x-8<56$ $3x<64$ $x<21.3$ The largest prime number is 19	M1 A1
2	$-2a+15b$	B1
3	$4(x^3-5y)(x^3+5y)$	B1 for $4(x^3-5y)(x^3+5y)$ or $(2x^3-10y)(2x^3+10y)$ seen
4(a)		B1
(b)	$p=-3$	B1
5	Total number of rhinos $=27000\left(1+\frac{3}{100}\right)^4$ $=30388.73\approx 30000$	M1 A1

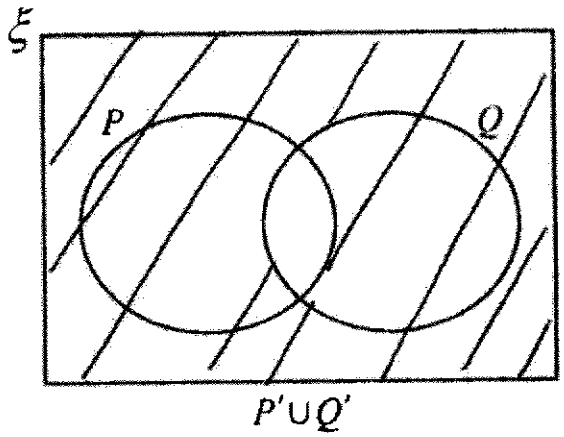
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No.	Answers	Marks
6		90° for French --- B1 Thai and Japanese with correct angles measured --- B1
7		B1 --- perpendicular line of *GH* drawn. B1--- for the circle drawn passing through *F, G* and *H* and has the centre at the intersection of the two lines

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No.	Answers	Marks
8(a)	$2420 = 2^2 \times 5 \times 11^2$ **Not all the powers of the prime factors are multiples of 3**, hence 2420 is not a perfect cube.	B1 B1
(b)	LCM $= 2420 = 2^2 \times 5 \times 11^2$ HCF $= 110 = 2 \times 5 \times 11$ The two numbers are $2^2 \times 5 \times 11 = 220$ and $2 \times 5 \times 11^2 = 1210$	 B1 , B1
9(a)	$\left(\frac{27x^{15}}{8y^{12}}\right)^{-\frac{1}{3}} = \left(\frac{8y^{12}}{27x^{15}}\right)^{\frac{1}{3}}$ $= \frac{2y^4}{3x^5}$	 B1 for $2y^4$ B1 for $3x^5$
(b)(i)	$(y-2)(4x+1)$	B1 , B1
(ii)	$(y-2)(4x+1) = 0$ $y = 2$ or $x = -\frac{1}{4}$	√ √B1 for both correct values
10(a)	For the vertical bars, the area of each bar is not directly proportional to the height, hence readers might be misled that the amount spent on hotel stays in 2021 is about 4 times that in 2020 instead of only 2 times as shown by the height. [Accept other reasonable responses]	B1 for misleading fact B1 for explanation of why this misleading fact cause misinterpretation.
(b)	The chart **does not support her claim** because between 2021 and 2022, the amount spent on flight increases but the amount spent on hotel stays decreases. [Accept other reasonable responses]	B1

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No.	Answers	Marks
11(a) **(i)**	$\subset$	B1
(ii)	$\notin$	B1
(b)	 $P' \cup Q'$	B1
(c)(i)	$x = 21$	B1
(ii)	$\left(\frac{21}{120}\times\frac{20}{119}\times\frac{74}{118}\right)+\left(\frac{74}{120}\times\frac{21}{119}\times\frac{20}{118}\right)+\left(\frac{21}{120}\times\frac{74}{119}\times\frac{20}{118}\right)$ $=\frac{111}{2006}$ or 0.0553 Alternative Method $\left(\frac{21}{120}\times\frac{20}{119}\times\frac{74}{118}\right)\times 3=\frac{111}{2006}$ or 0.0553	M1 for $\frac{21}{120}\times\frac{20}{119}\times\frac{74}{118}$ seen M1 for addition A1 M2 + A1
12	3, 5, 5, 7, 10 or 4 , 5, 5, 5, 11	B1
13(a)	10 : 4 : 7	B1
(b)	Flour : Sugar : Butter 1500 : 500 : 1000 $1500 \div 250 = 6$ $500 \div 100 = 5$ $1000 \div 175 = 5$ Maximum number of biscuits made $= 5 \times 25$ $= 125$	M1 A1

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No.	Answers	Marks
14(a)	$x^2-5x+9=(x-2.5)^2-\frac{25}{4}+9$ $=\frac{11}{4}+(x-2.5)^2$ $p=\frac{11}{4}$ or $p=2.75$	 B1
(b)	$x=\frac{5}{2}$ or $x=2.5$	B1
15(a)	$y=-\frac{2}{5}x+4$	B1 for the correct gradient B1 for the correct y-intercept
(b)	Let the shortest distance from P to line L be h . Let θ be the angle made between the line and the x-axis. $\tan\theta=\frac{4}{10}\Rightarrow\theta=21.8014^0$ $\frac{h}{7}=\sin 21.8014$ $h=7\times 0.713\approx 2.60$ <u>Alternative Method</u> $\frac{h}{4}=\frac{7}{\sqrt{116}}$ $h=\frac{28}{\sqrt{116}}\approx 2.60$	 M1 M1 A1 M1 , B1 for $\sqrt{116}$ seen A1
16	Interior angle of polygon A $=360^0-135^0-60^0=165^0$ Let n be the number of sides of polygon A. $\frac{(n-2)\times 180}{n}=165$ $180n-360=165n$ $n=\frac{360}{15}=24$	B1 M1 A1

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No.	Answers	Marks
17	$P=\frac{k}{\sqrt{Q}}$ $\frac{k}{\sqrt{9}}+\frac{k}{\sqrt{16}}=21$ $\frac{k}{3}+\frac{k}{4}=21$ $\frac{7k}{12}=21$ $7k=252$ $k=36$ $\frac{36}{\sqrt{Q}}=100$ $Q=\left(\frac{36}{100}\right)^2=0.1296$ [Accept $\frac{81}{625}$]	M1 M1 A1
18(a)	Perimeter $=\frac{216}{360}\times 2\times\pi\times 10+20$ $=12\pi+20$	M1 for $\frac{216}{360}\times 2\times\pi\times 10$
(b)	$2\pi r=12\pi$ $r=6$ Height of the cone $=\sqrt{10^2-6^2}=8$ Volume of the cone $=\frac{1}{3}\times\pi\times 6^2\times 8$ $=301.59\approx 302$	M1 M1 M1 A1
19	$AD=BC$ (opposite length of parallelogram) $\angle EAD=\angle ADB=\angle DBC$ (alternate angle) $\angle EDA=\angle EDP-\angle ADP$ $=\angle DPC-\angle DBC$ (alternate angle) $=\angle PCB$ (exterior angle) $\therefore \Delta BCP\equiv\Delta ADE$ (ASA)	B1 B1 B1 for using alternate angle B1 for using exterior angle or other equivalent reason to conclude that $\angle EDA=\angle PCB$ A1 for ASA shown

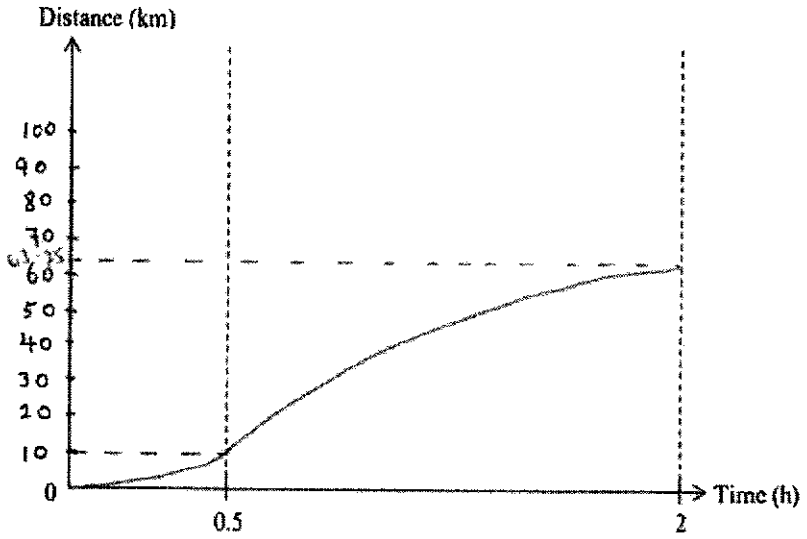
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No.	Answers	Marks
20(a) (i)	6 , 12, 22, 36	B1
(ii)	$2n^2+4=2(n^2+2)$ is a multiple of 2 for all values of n, hence it is an even number and not an odd number.	B1
(b)	$2k^2-3$	B1
21	$\frac{4x+5}{x}=\frac{4x+11}{x+2}$ $(4x+5)(x+2)=x(4x+11)$ $4x^2+13x+10=4x^2+11x$ $2x=-10$ $x=-5$	M1 M1 A1
22(a)	47	B1
(b)	20.5	B1
(c)	1. On average Team B scored more points than Team A as their median score was 53 which was higher than the median score of 47 achieved by Team A. 2. The interquartile range of Team B was higher than that of Team A which was 17.5. Hence the scores for Team B was more widely spread out.	B1 B1
(d)	There is **an outlier** in the distribution scores of Team A which is significantly greater than the rest of the scores.	B1

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No.	Answers	Marks
23(a)	$\begin{pmatrix} 560 & 420 & 140 \\ 490 & 280 & 280 \end{pmatrix}$	B1
(b)	$T = \begin{pmatrix} 1.25 & 2.50 \end{pmatrix}\begin{pmatrix} 560 & 420 & 140 \\ 490 & 280 & 280 \end{pmatrix}$ $= \begin{pmatrix} 1925 & 1225 & 875 \end{pmatrix}$	 B1
(c)	The total cost of the small and large vegetarian pies	B1
24(a)	$\angle DOB = 68 \times 2 = 136^0$ (angle at centre = twice angle on circumference) $\angle BCD = 180 - 68 = 112^0$ (angles in opposite segment) $\angle ODC = 360 - 52 - 136 - 112 = 60^0$ (sum of angles in a quadrilateral is 360°)	B1 for correct reasoning B1 for correct reasoning B1
(b)	Area of the shaded segment = Area of sector OCB − Area of triangle OCB $= \frac{76}{360} \times \pi \times 5^2 - \frac{1}{2} \times 5^2 \times \sin 76^0$ $= 4.451932$ $= 4.45 \text{ cm}^2$	 M1 , M1 A1

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No.	Answers	Marks
25	Curved surface of the small hemisphere $= 2\pi(3.6)^2 = 25.92\pi \text{ cm}^2$ Curved surface area of the cylinder $= 2\pi(3.6)(6.5) = 46.8\pi \text{ cm}^2$ Total surface area of the large hemisphere $= 2\pi(5.4)^2 + \pi(5.4^2 - 3.6^2) = 74.52\pi \text{ cm}^2$ Total surface area of the **solid** $25.92\pi + 46.8\pi + 74.52\pi = 462.56 \approx 463 \text{ cm}^2$	M1 M1 M1 , M1 A1
26(a)	$\frac{40 - v}{0.5 - 2} = -6$ $v = 31$	M1 A1
(b)		B1 for correct curve drawn from t = 0 to t=0.5h B1 for correct curve drawn from t = 0.5h to t = 2h B1 for values 10 and 63.25 labelled correctly on the vertical axis

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Tampines Secondary School

Sec 4 Prelim Math Paper 2 2024 Marking Scheme

Total Marks: 90

√ = follow through

No.	Answers	Marks
1a	$\frac{6(a+1)^3}{7b}\times\frac{28b}{9(a+1)}$ $=\frac{2(a+1)^2}{1}\times\frac{4}{3}$ $=\frac{8(a+1)^2}{3}$	B1 (for $(a+1)^2$ seen) B1 (for $\frac{8}{3}$ seen)
1bi	$x=a+\frac{bv^2}{k}$ $x=2+\frac{3(-4)^2}{5}=11.6$	B1
1bii	$x=a+\frac{bv^2}{k}$ $x-a=\frac{bv^2}{k}$ $k(x-a)=bv^2$ $\frac{k(x-a)}{b}=v^2$ $v=\pm\sqrt{\frac{k(x-a)}{b}}$	M1 (elimination of fraction) M1 (square root) A1 (± seen)
1c	$4x+7y=-23$ ------- (1) $6x-2y=3$ ---------- (2) $(1)\times3: 12x+21y=-69$ ----- (3) $(2)\times2: 12x-4y=6$ ---------- (4) $(3)-(4): 25y=-75$ $y=-3$ $x=-0.5$	M1 (correct method to eliminate one variable) A1 A1
1d	$\frac{x^2-(x-y)(x+y)}{(x+y)(x-3y)}$ $=\frac{x^2-(x^2-y^2)}{(x+y)(x-3y)}$ $=\frac{y^2}{(x+y)(x-3y)}$	M1 A1 (accept expanded denominator) ***11 marks***

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No.	Answers	Marks
2a	$1500 = \dfrac{25000 \times R \times \frac{9}{12}}{100}$ $R = 8$ Rate is 8%	M1 (or equivalent) A1
2b	\$1 = 26.77 THB \$500 = 500 x 26.77 = 13385 THB Money left = 13385 – 10600 = 2785 THB 26.88 THB = \$1 2785 THB = $\frac{2785}{26.88}$ = \$103.61	M1 (get remaining amount of money left in THB) A1 (nearest cent)
2c	Deposit = $\frac{15}{100} \times 2700 = \$405$ Total instalments = 68 x 36 = \$2448 Total paid = 405 + 2448 = \$2853 Interest = 2853 – 2700 = \$153 % required = $\frac{153}{2700} \times 100 = 5.67\%$ $(5\frac{2}{3}\%)$	M1 (calculate both deposit & instalments) M1 (their interest √ ÷ cash price x 100) A1
2d	100% → \$180 110% → $\frac{110}{100} \times 180 = \$198$ 75% → \$198 100% → $\frac{100}{75} \times 198 = \$264$	M1 (find discounted price) M1 (√ from above discounted price) A1 ***10 marks***

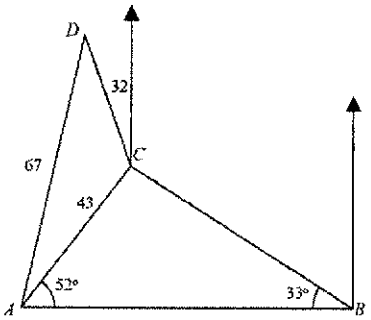
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No.	Answers	Marks
3a	length of box $= 3x+1-3-3 = (3x-5)cm$ width of box $= x+13-3-3 = (x+7)cm$ height of box $= 3cm$ $volume = 3(3x-5)(x+7)$ $930 = 3(3x^2+21x-5x-35)$ $310 = 3x^2+16x-35$ $3x^2+16x-345 = 0$	B1 (Length & width) M1 √ M1 (expansion √) A1 (establish the equation)
3b	$x = \dfrac{-16 \pm \sqrt{16^2-4(3)(-345)}}{2(3)}$ $x = 8.38$ or $x = -13.72$	B1 B1 B1
3c	Length of box = 3(8.38) – 5 = 20.14cm Width = 8.38 + 7 = 15.38 cm Length of SQ = $\sqrt{20.14^2+15.38^2} = 25.3$ cm	M1 (√ find either length or width with Q3b value) M1 & A1 √ ***10 marks***

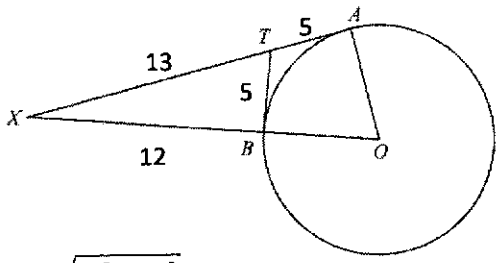
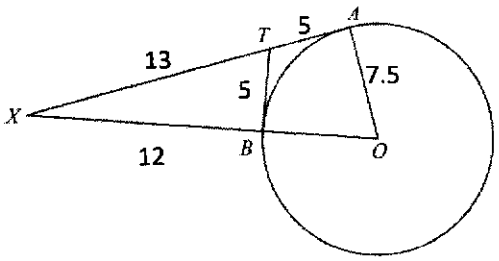
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No.	Answers	Marks
4ai	$\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB}$ $= \begin{pmatrix} -3 \\ -7 \end{pmatrix} + \begin{pmatrix} 13 \\ -8 \end{pmatrix}$ $= \begin{pmatrix} 10 \\ -15 \end{pmatrix}$ $\left\lvert \begin{pmatrix} 10 \\ -15 \end{pmatrix} \right\rvert = \sqrt{10^2 + (-15)^2} = 18.0$	M1 or use length formula A1
4aii	$\overrightarrow{BA} = 2\overrightarrow{AP}$ $\begin{pmatrix} -10 \\ 15 \end{pmatrix} = 2(\overrightarrow{AO} + \overrightarrow{OP})$ $\begin{pmatrix} -5 \\ 7.5 \end{pmatrix} = \begin{pmatrix} -3 \\ -7 \end{pmatrix} + \overrightarrow{OP}$ $\overrightarrow{OP} = \begin{pmatrix} -2 \\ 14.5 \end{pmatrix}$ P (-2, 14.5)	M1 A1
4b(i)	$\overrightarrow{CP} = \frac{3}{4}\overrightarrow{CB}$ $= \frac{3}{4}(-4\underline{a} + 2\underline{b})$ $= -3\underline{a} + \frac{3}{2}\underline{b}$	B1 for $\overrightarrow{CB}$ B1
4b(ii)	$\overrightarrow{AP} = \overrightarrow{AC} + \overrightarrow{CP}$ $= 2\underline{a} - 3\underline{a} + \frac{3}{2}\underline{b}$ $= -\underline{a} + \frac{3}{2}\underline{b}$	B1
4b(iii)	$\overrightarrow{AD} = -2\underline{a} + 3\underline{b}$ $\overrightarrow{AD} = 2(-\underline{a} + \frac{3}{2}\underline{b})$ $= 2\overrightarrow{AP}$ $\overrightarrow{AD}$ is a scalar multiple of $\overrightarrow{AP}$, AD and AP are parallel with A as the common point. $\therefore$ A, D and P lie on the same straight line.	B1 (or find $\overrightarrow{PD}$) M1 (express one vector as a scalar multiple of the other) A1
4b(iv)	$Area OCB : Area CBD : Area CPD$ 2 : 1 4 : 3 Answer: $\frac{8}{3}$	B1 ***11 marks***

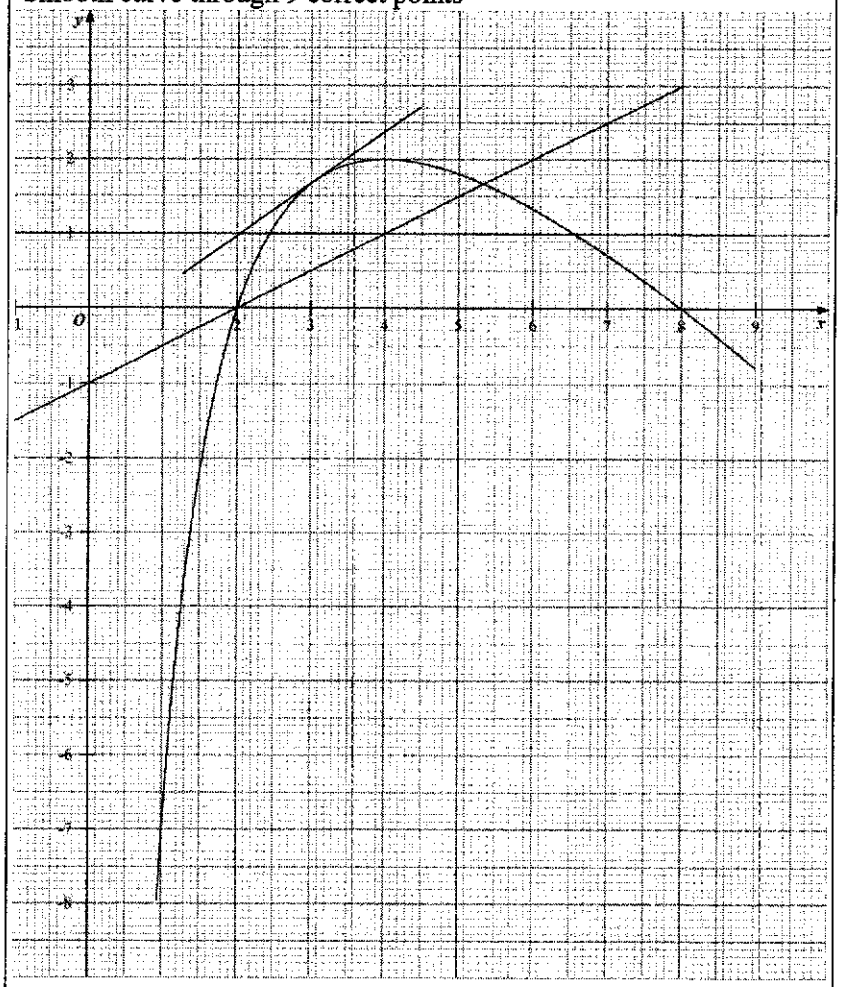
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No.	Answers	Marks
5a	 Bearing of B from C = 180 – (90 – 33) =123°	M1 A1
5b	$\frac{AB}{\sin(180-52-33)^o}=\frac{43}{\sin 33^o}$ $AB=78.65=78.7m(3sf)$	M1 A1
5c	$\cos\angle CDA=\frac{67^2+32^2-43^2}{2(67)(32)}$ $\angle CDA=31.297=31.3^o(1dp)$	M2 A1
5d	$\tan\theta=\frac{60}{67}$ $\theta=41.84=41.8^o(1dp)$	M1 A1 ***9 marks***

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No.	Answers	Marks
6a	$\angle OAT = \angle OBT = 90^\circ$ (radius $\perp$ tangent) $\therefore \angle OAX = \angle TBX = 90^\circ$ $\angle AXO = \angle BXT$ (common angle) $\angle AOX = \angle BTX$ (3rd angle in triangle) $\therefore \Delta OAX$ and ΔTBX are similar.	B2 for the first 3 or all statements seen (B1 for one correct pair of angles with reason)
6bi	 $TB = \sqrt{13^2 - 12^2} = 5$ $TA = TB = 5cm$ (tangents from external point) $\frac{OA}{5} = \frac{18}{12}$ $OA = 7.5$	M1 (TB = 5 seen) M1 (form ratio to find OA oe) A1
6bii	$\frac{area\ \Delta TBX}{area\ \Delta OAX} = \left(\frac{12}{18}\right)^2 = \frac{4}{9}$ $\frac{area\ \Delta TBX}{area\ \text{quad}\ OATB} = \frac{4}{5}$	B1 A1
6biii	 $\tan \angle AOX = \frac{18}{7.5}$ $\angle AOX = 67.38^\circ$ Reflex $\angle AOB = 360 - 67.38 = 292.62^\circ$ In radian, $\frac{292.62}{180} \times \pi = 5.11 rad$ (3sf)	M1 (oe for $\angle AOX$) M1 (conversion) A1 ***10 marks***

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7a	2	B1
7b	Smooth curve through 9 correct points 	B3 Or (B2FT for 9 points correct) Or (B1FT for 7 or 8 points correct)
7c	Gradient value between 0.6 to 0.9 [exact value is $\frac{7}{9} = 0.\dot{7}$]	M1 tangent line at x = 3 A1
7d	$9 - x - \frac{16}{x} = 0$ $10 - x - \frac{16}{x} = 1$ $y = 1$ $x = [2.3 - 2.5]$ or $x = [6.5 - 6.7]$	A1 A1
7e(i)	$10 - x - \frac{16}{x} = mx - 1$ $10x - x^2 - 16 = mx^2 - x$ $mx^2 + x^2 - 11x + 16 = 0$ $(m+1)x^2 - 11x + 16 = 0$	M1 [elimination of fraction] B1
7e(ii)	$\frac{1}{2}$	B1 ***11 marks***

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8a(i)	48 g	B1
8a(ii)	51 – 45 or 51.5 – 45 = 6 g = 6.5 g	B1 (for LQ or UQ) A1
8a(iii)	40 g	B1
8b	$260 - 200 = 60$ $\frac{60}{300} \times \frac{59}{299} = \frac{59}{1495}$	M1 A1 (accept 0.0395)
8c(i)	1st batch of eggs: interquartile range = 6 g (6.5g) 2nd batch of eggs: interquartile range = 10 g Since 6 g < 10 g, the mass of the 1st batch varies less widely, hence the mass is more consistent.	B1
8c(ii)	The mass of the top 25% varies more widely than the bottom 25%.	B1 ***8 marks***
9a	p = 0.2979 (4 dp) r = 11.03 (2 dp) s = 133.62 (2 dp)	B3 (for each answer)
9b	July National average electricity usage = 505 kWh Current July usage = 289 kWh Additional usage = 505 – 289 = 216 kWh Additional amount = 216 x 0.2979 (rate) = \$64.3464 = \$64.35 Monthly cost (from air-con) must be < \$64.35 *4 & 5 ticks model selected* Model / monthly cost (\$) / LCC (\$) B: 616 ÷ 12 = **51.33** / 2749 + 616 x 7 = **7061** C: 789 ÷ 12 = 65.75 / 1989 + 789 x 7 = 7512 D: 552 ÷ 12 = **46** / 3499 + 552 x 7 = **7363** E: 594 ÷ 12 = **49.50** / 3305 + 594 x 7 = 7463 Chen should opt for Model D which has the lowest monthly cost (< \$64.35) and the LCC is the second lowest among the four models. Estimated August bill = 1.09 x (122.59 + 46) = \$183.76	M1 M1 M1 M1 (monthly cost) M1 (LCC) Calculated for BCDE or DE A1 A1 ***10 marks***

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