Name	Class				Index Number		

BROADRICK SECONDARY SCHOOL
SECONDARY 4 EXPRESS / SECONDARY 5 NORMAL ACADEMIC PRELIMINARY EXAMINATION 2024

MATHEMATICS 4052/01

Paper 1 **Aug 2024**

Candidates answer on the Question Paper **2 hours 15 minutes**

READ THESE INSTRUCTIONS FIRST

Write your name, class and index 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** 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 of the marks for this paper is 90.

For Examiner's Use		
Error In	**Question Number**	**Marks Deducted**
Rounding-off		
Reasoning		
Presentation		

For Examiner's Use
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 $= \pi rl$

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

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

Trigonometry

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

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

Statistics

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

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

Errata
Q13b -- For P>10 instead of P>/= 0

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Answer **all** the questions.

1 Evaluate $\dfrac{(-3.85)^2-\sqrt{10-0.9\times(-6)}}{3.11-4^3}$, giving your answer to 4 significant figures.

Answer ..... [1]

---

2 The frequency table shows the reaction time, t seconds, for a chemical to change the colour of the litmus paper in 100 laboratory sessions.

Time (t sec)	$0 < t \leq 1$	$1 < t \leq 2$	$2 < t \leq 3$	$3 < t \leq 4$	$4 < t \leq 5$
Frequency	8	28	44	18	2

Calculate an estimate for the

(a) mean reaction time,

Answer ..... s [1]

(b) standard deviation of the reaction times.

Answer ..... s [1]

---

3 Given that $\dfrac{5^x}{2^{2x}\times 5^{3-x}} = 2^m 5^n$, express m and n in terms of x.

Answer $m =$
.....

$n =$ [2]

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.....

4 The highest common factor of two numbers is 18.
The lowest common multiple of the two numbers is 324.
Both numbers are greater than 20.

Find the two numbers.

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

---

5 A map has a scale of 1 : 50 000.

(a) The distance between two towns on the map is 7.5 cm.
Calculate the actual distance between the two towns in kilometres.

Answer ..... km [1]

(b) A lake covers an actual area of 2.25 square kilometres.
Find the area of the lake on the map in square centimetres.

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

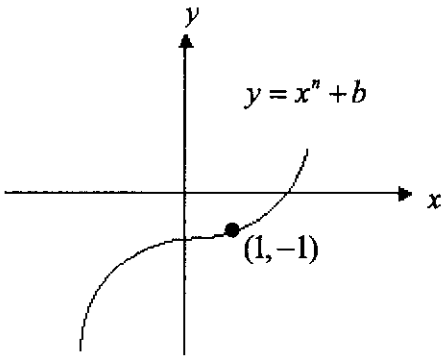
6 A wooden block has a mass of 115 grams, correct to the nearest gram.
The volume of the block is 6 cm^3, correct to the nearest cm^3.
Find the largest possible density of the block in g/cm^3.

$$Density = \frac{Mass}{Volume}$$

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

---

7 In the following graph, write down a possible value of n and the corresponding value of b for the equation.

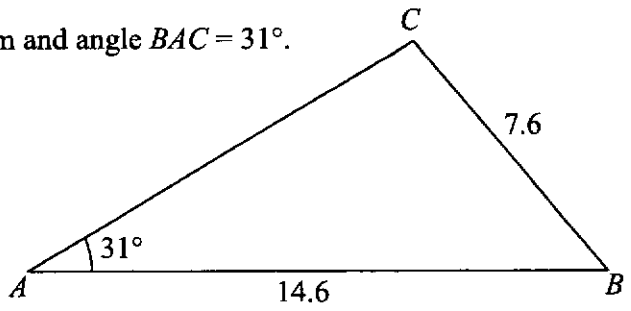


Answer n = ...

b = ... [2]

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8 In triangle ABC, $AB = 14.6$ cm, $BC = 7.6$ cm and angle $BAC = 31°$.



Find

(a) obtuse angle ACB,

Answer ..... ° [2]

(b) area of triangle ABC.

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

---

9 Keila travels from Singapore to Japan.
She wants to change 850 Singapore dollars ($) into Yen (¥).

The exchange rate in Singapore is \$100 = ¥11600 and the exchange rate in Japan is ¥1 = \$0.0086.
She claims that she will receive more if she changes the money in Singapore.
Justify if her claim is true.
Show your working.

Answer

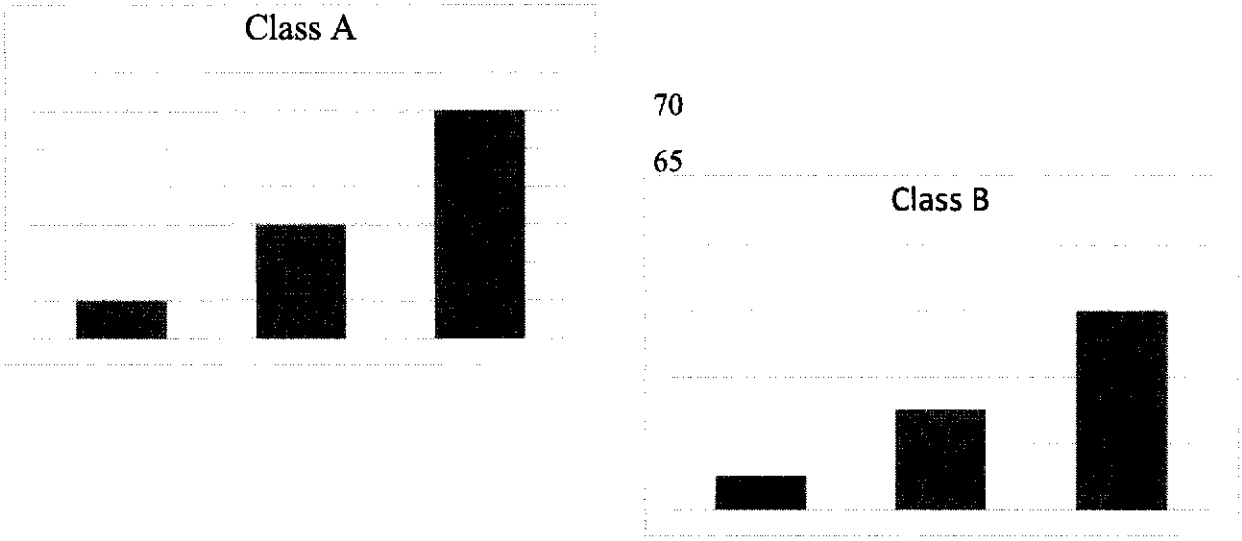
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..... [3]

10 The graphs below show the average test scores of Class *A* and Class *B* over three consecutive years.



(a) What feature of the graph misleads readers to think that the scores of Class *A* in 2022 had increased to 6 times that in 2024?

.....

.....

..... [1]

(b) Hailey claims that the scores of Class *A* and Class *B* shows the same improvement from 2022 to 2024.
Do you agree?
Explain your answer.

.....

.....

.....

.....

..... [1]

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11 The number $2^p \times 5^q \times \frac{5}{2}$ is a perfect cube where p and q are greater than 1.
Find the smallest possible integer values of p and of q.

Answer $p =$ .....

$q =$ ..... [2]

---

12 (a) Simplify $\left(16y^3\right)^{\frac{3}{2}}$.

Answer ..... [1]

(b) $5^k = 125\sqrt[3]{5\sqrt{5}}$
Use laws of indices to find the value of k.
Show your working.

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Answer $k =$ ..... [3]

13 Given that $\xi = \{\text{integers } x : \ p \le x < 20\}$
$A = \{\text{factors of } 24\}$
$B = \{\text{prime numbers}\}$
$C = \{\text{perfect squares}\}$

(a) List the elements of A if $p = 2$.

Answer ..... [1]

(b) For $p \ge 0$, list the elements of $(B \cup C)'$ such that $\mathrm{n}(B \cup C)' = 4$.

Answer ..... [1]

(c) Find the smallest p such that $A \cap C = \varnothing$.

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

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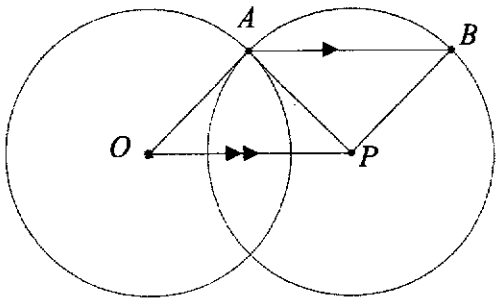
14 A company divided a bonus among its employees A, B, and C in the ratio 2 : 3 : 7.
C's bonus was X% more than the combined bonus of A and B.
Find X.

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Answer $X =$ ..... [2]

15 In the diagram, two circles with centres O and P respectively intersects at A.
The two circles have the same radius and AB // OP.
Show that $AB = OP$.

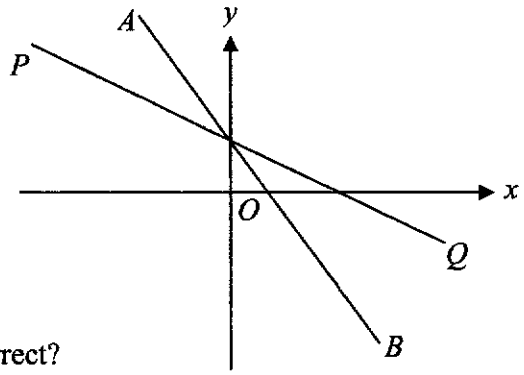
Answer



[3]

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16 (a) Leanne says that the equation of the line AB is $2y = -4x + 1$ and the equation of the line PQ is $4y = -9x + 2$.



Is she correct?
Explain your answer.

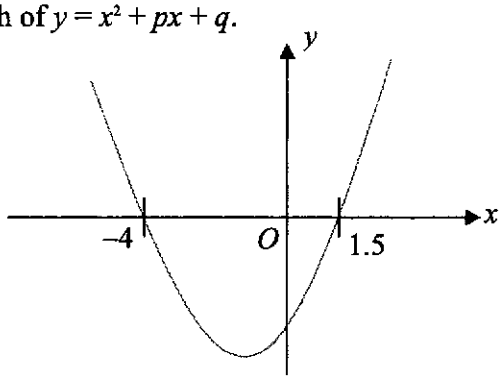
.....

.....

.....

..... [2]

(b) The diagram shows the graph of $y = x^2 + px + q$.



(i) Write down equation of the graph in the form $y = x^2 + px + q$.

Answer ..... [2]

(ii) Find the coordinates of the minimum point.

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

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17

Write as a single fraction in its simplest form .

Answer ..... [2]

---

18 (a) Factorise completely.

(i) $24a^2b+12ab^2-ab$

Answer ..... [1]

(ii) $mn-18-9m+2n$

Answer ..... [2]

(b) Expand and simplify $(-2x+3q)(x-2q)$.

Answer ..... [2]

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19 Rayden invested \$20 000 at a rate of 0.3% per month compound interest.

(a) Find the value of his investment at the end of 2 years.

Answer \$ ..... [2]

(b) Rayden then withdrew $\frac{1}{5}$ of the accumulated amount at the end of the 2 years. Find the new rate of compound interest per month so that his remaining investment reaches the same value in **(a)** in another 3 years.

Answer ..... % [2]

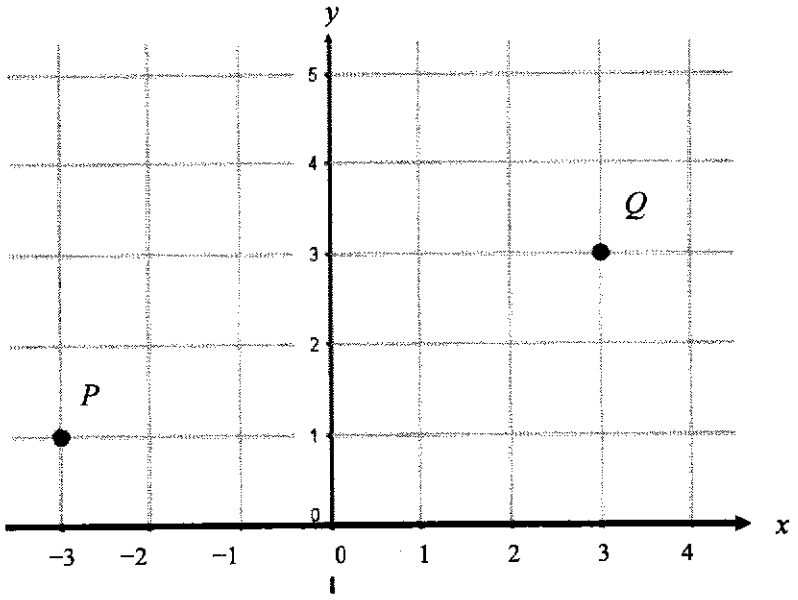
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20 Simplify $\dfrac{2x^2-5xy-12y^2}{x^2-16y^2}$.

Answer ..... [3]

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21 P is the point $(-3, 1)$ and Q is the point $(3, 3)$.



(a) Find the length of the PQ.

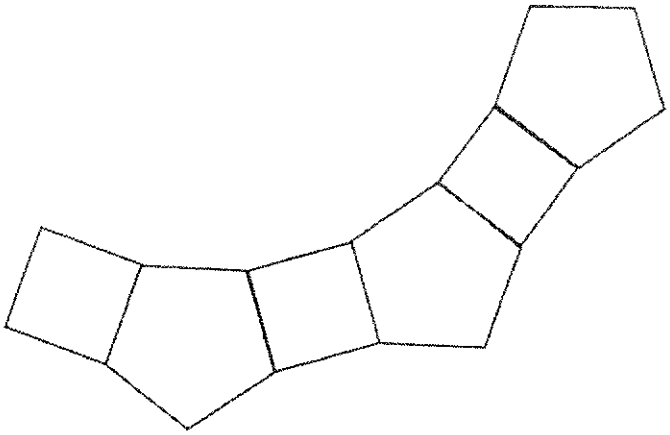
Answer ..... units [2]

(b) The point R is such that PQR forms an isosceles triangle.
The angle bisector of angle PQR has an equation of $y = x$.
Find the coordinates of R.

Answer (....., ...) [1]

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22 Regular pentagons and squares of the same sides are placed together in a pattern as shown in the diagram.
Caleb claims that if he continues the pattern, a closed loop will form.
Explain whether his claim is true, showing your working clearly.



Answer

.....

.....

..... [3]

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23 A cylinder X has radius, r cm and height h cm.
A hemisphere S is such that its radius is half of the radius of cylinder X.

(a) The volume of the cylinder is 4 times that of the hemisphere.
Express h in terms of r.

Answer $h =$ ..... [3]

(b) Another cylinder Y is geometrically similar to cylinder X.
The ratio of the curved surface area of $X : Y = 9 : 4$.
Find the height of cylinder Y in terms of r.

Answer ..... [2]

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24 The sum of the first n terms of a linear sequence is .

(a) Show that the sum of the first n terms in the sequence is always even.

.....

.....

.....

.....

..... [2]

(b) By finding the first three terms in the sequence or otherwise, find, in terms of n, an expression for the nth term of the sequence.

Answer ..... [2]

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25 In bookstore A, a fiction book costs \$8, a non-fiction book costs \$10 and a science book costs \$11.50.
In bookstore B, a fiction book costs \$1.10 less, a non-fiction book costs \$2.80 less and a science book costs \$1.50 more than that in bookstore A.

	A	B
F		
NF		
S		

The information can be represented by the matrix

(a) Kevin bought 4 fiction books, 3 non-fiction books and 2 science books.
Molly bought 2 fiction book and x science books.
Represent their purchases, in terms of x, in a 2×3 matrix **P**.

Answer **P** = [1]

(b) Evaluate the matrix **R** = **PQ**.

Answer **R** = [2]

(c) Explain what the elements in the first column of matrix **R** represent.

.....

.....

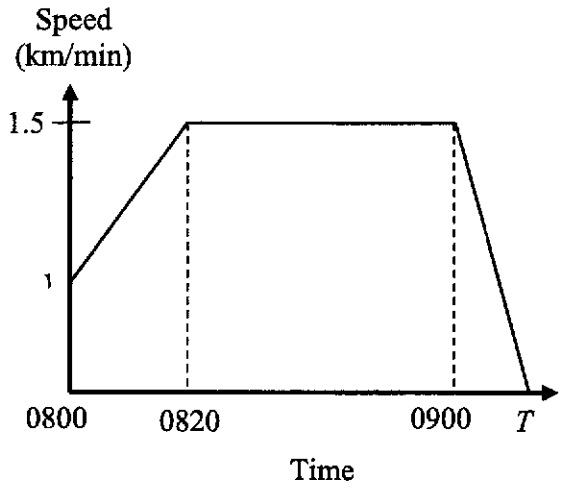
..... [1]

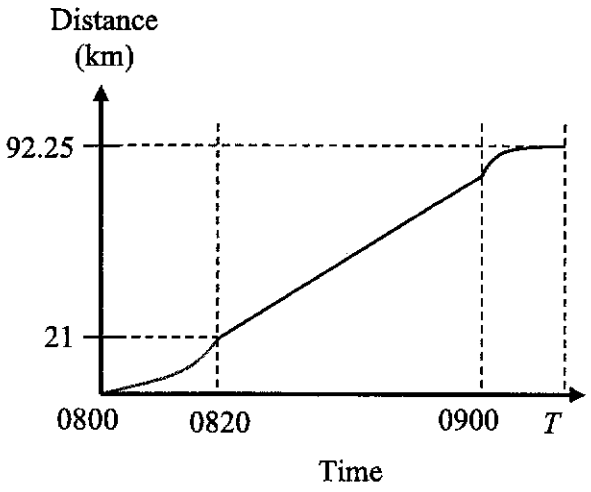
(d) Molly can save \$5.30 by purchasing in bookstore A.
Using your answer in **(b)**, find the value of x.

Answer x = ... [1]

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26 The diagrams show the speed-time graph and the corresponding distance-time graph of a car.
The car travelled from a point P to Q and in the journey, its greatest speed attained was 1.5 km/min.





(a) Convert 1.5 km/min to m/s.

Answer .....m/s [1]

(b) Show that v, the initial speed, was 0.6 km/min.

[2]

(c) Find the speed of the car, in m/s, at 0812.

Answer .....m/s [2]

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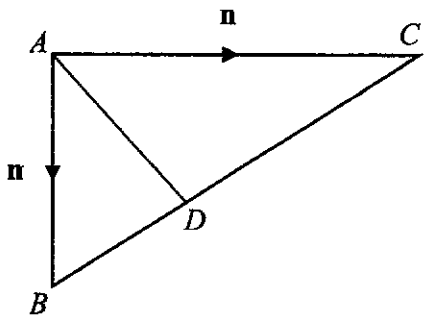
(d) The total distance travelled by the car is 92.25 km.
Find the time, T, when it comes to a complete stop.

Answer ..... [2]

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27 ABC is a triangle.
D is the point on BC such that $3BD = 2DC$.

and .



(a) Find $\overrightarrow{AD}$ in terms of **m** and **n**.

Answer ..... [2]

(b) R is on AD produced such that $\overrightarrow{AR} = k\overrightarrow{AD}$ and AC is parallel to BR.

(i) Show that $k = \frac{5}{3}$.
Answer

[3]

(ii) Find the ratio $\frac{\text{area of triangle } ABD}{\text{area of triangle } RBD}$.

Answer ..... [1]

End of Paper

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Paper 1 Answer Key

1	-0.17898 = -0.1790
2a	Mean = $\frac{228}{100}$ = 2.28 s
b	0.901 s (3sf)
3	$m = -2x$ $n = 2x - 3$
4	X = $2^2 \times 3^2 = 36$ Y = $2 \times 3^4 = 162$
5a	3.75 km
b	9 cm^2
6	21 g/ cm^3
7	$n = 3$ or 5 (any odd integer more than 1) $b = -2$
8a	98.3° (1dp)
b	42.9 cm^2 (3sf)
9	Her claim is not true. She will receive (237.21 Yen) more if she changes in Japan.
10a	The vertical axis did not start from 0. (Optional: The scores in 2022 looked like it had increased to 6 times but the increase was from 55 to 80 (which is slightly less than double.)
b	I disagree. Although the increase in the height of the bar looks the same from 2022 to 2024 for both classes, the scale of the two graphs are different. It exaggerates the increase in test scores of Class B.
11	$p = 4$ $q = 2$
12a	$64y^{\frac{9}{2}}$
b	$k = 3\frac{1}{2}$
13a	A={2,3,4,6,8,12}
b	$(B \cup C)' = \{12,14,15,18\}$
c	smallest p = 5
14	40%
15	$\Delta OPA \equiv \Delta BAP$ (AAS) Hence $AB = OP$
16a	The gradient of PQ should be steeper than that of AB. Hence she is not correct.
bi	$y = x^2 + 2.5x - 6$
bii	Min point (-1.25, -7.5625)
17	$= \frac{4x^2 - 10x + 4}{(3x-1)(2x+1)}$

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18ai	$= ab(24a+12b-1)$
aii	$(m+2)(n-9)$
b	$= -2x^2+7xq-6q^2$
19a	= \$21490.79 (2dp)
b	$r = 0.622\%$
20	$= \dfrac{2x+3y}{x+4y}$
21a	= 6.32 units (3sf)
b	R is (1, −3)
22	$n = \dfrac{360}{18} = 20$ Since n is a positive integer, it is possible to form a regular polygon, hence a closed loop.
23a	$h = \dfrac{1}{3}r$
b	$H = \dfrac{2}{9}r$
24a	$5n^2 - n = n(5n-1)$
b	$10n-6$
25a	$P = \begin{pmatrix} 4 & 3 & 2 \\ 2 & 0 & x \end{pmatrix}$
b	$= \begin{pmatrix} 85 & -9.8 \\ 16+11.5x & -2.2+1.5x \end{pmatrix}$
c	It represents the amount of money Kevin and Molly spent respectively at Bookstore A.
d	$x = 5$
26a	25 m/s
b	Area = dist travelled
c	19m/s
d	T is 0915
27a	$= \dfrac{3}{5}\mathbf{m} + \dfrac{2}{5}\mathbf{n}$
bii	$\dfrac{3}{2}$

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Name	Class				Index Number		

BROADRICK SECONDARY SCHOOL
SECONDARY 4 EXPRESS / SECONDARY 5 NORMAL ACADEMIC PRELIMINARY EXAMINATION 2024

MATHEMATICS **4052/02**

Paper 2 **Aug 2024**

Candidates answer on the Question Paper. **2 hours 15 minutes**

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Error In	Question Number	Marks Deducted
Rounding-off		
Reasoning		
Presentation		

For Candidate's Use	For Examiner's Use
Question Number	Marks Obtained
1	/5
2	/10
3	/10
4	/9
5	/9
6	/10
7	/10
8	/10
9	/7
10	/10
Total Marks	/90

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Mathematical Formulae

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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

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

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

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Answer **all** the questions.

1 A company produces phones.
In 2023, the company produced 3.6 million smartphones.

(a) Due to increased demand, the company produced 4.2 million smartphones in 2024.
Express this production figure in standard form.

Answer ..... [1]

(b) Calculate the percentage increase in smartphone production from 2023 to 2024.

Answer ..... % [2]

(c) In 2023, 4% of the total phones produced were not smartphones.
Calculate the total number of phones produced in 2023.
Express your answer in standard form.

Answer ..... [2]

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2 **(a)** Solve .

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

(b) Solve the inequality $1-3p \geq 5$.

Answer ..... [1]

(c) $3A = \dfrac{Ap+h}{1-h}$

Rearrange the formula to make A the subject.

Answer $A =$ ..... [3]

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(d)

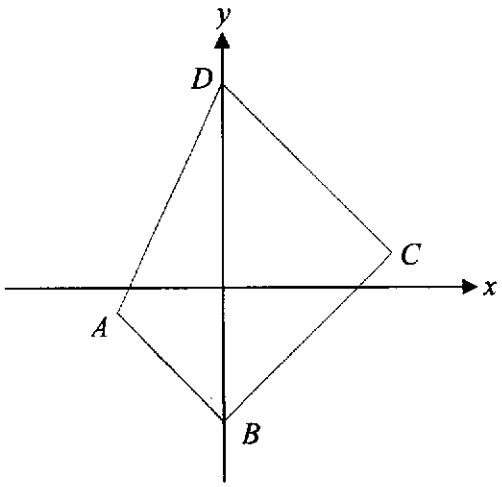
Solve the equation .

Give your answers correct to two decimal places.

Answer $x =$ ..... or ..... [4]

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3 A is the point and D is the point .
B is a point on the y-axis.



(a) The line AB is parallel to $3y+5x-6=0$.
Find the equation of the line AB.

Answer ..... [3]

(b) Find the coordinates of C such that it is equidistant from B and D and it lies on the line $y=7.5-x$.

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

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(c) Find the area of the quadrilateral *ABCD*.

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

(d) Find the size of angle *ABC*.

Answer .....° [3]

4 The table below shows the number of vertices (n) and number of diagonals (X) in

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a polygon.

Number of Vertices (n)	Number of diagonals (X)
3	0
4	2
5	5
6	9
...	
8	a

(a) Write down the value of a.

Answer $a =$ ..... [1]

(b) The number of diagonals is related to the number of vertices by the equation $X = pn^2 + qn$ where p and q are constants.

(i) Using appropriate substitution, show that $16p + 4q = 2$ and $25p + 5q = 5$.

Answer

[2]

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(ii) Solve these simultaneous equations to find the values of p and of q.

Answer $p =$ .....

$q =$ ..... [3]

(iii) Explain whether it is possible to have a n-sided polygon with 495 diagonals.

Show your working clearly.

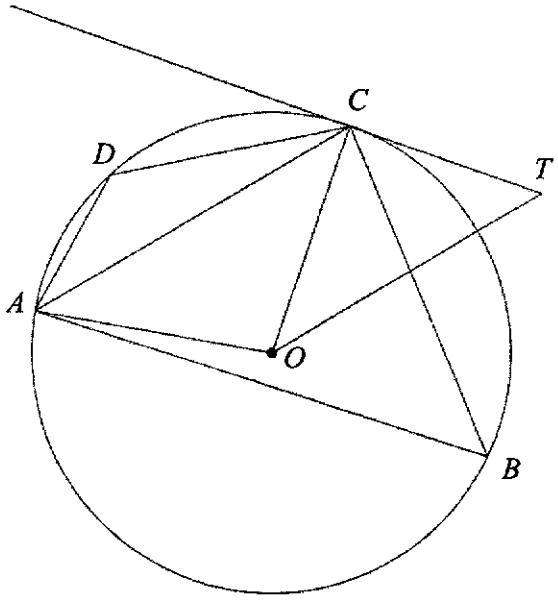
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.....

..... [3]

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5 In the diagram, A, B, C and D are points on the circle with centre O.
CT is tangent to the circle and AC is parallel to OT.
Angle $AOC = 100°$.



(a) Giving reason(s) for your workings, find

(i) angle ABC,

Answer Angle ABC = ……° [1]

(ii) angle ADC,

Answer Angle ADC = ……° [1]

(iii) angle OTC.

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Answer Angle OTC = ……° [3]

(b) Explain whether a circle can be drawn passing through the points A, O, C and D.

.....

.....

.....

..... [1]

(c) Given $CT = 4.8$ cm, find the area of the minor segment ADC.

Answer ..... cm² [3]

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

x	−2	−1	0	0.5	0.75	1.25	1.5	2	3	3.5	4
y		−2.5	−2	−2.5	−4.25	4.25	2.5	2	2.5	2.9	3.33

[1]

(b) On the grid opposite, draw the graph of $y = \frac{1}{x-1} + x - 1$ for $-2 \le x \le 4$. [3]

(c) The point P has the coordinates $(-1, 2)$.
A tangent to the curve can be drawn so that the tangent passes through P and its gradient < 0.

(i) Draw this tangent on the same grid. [1]

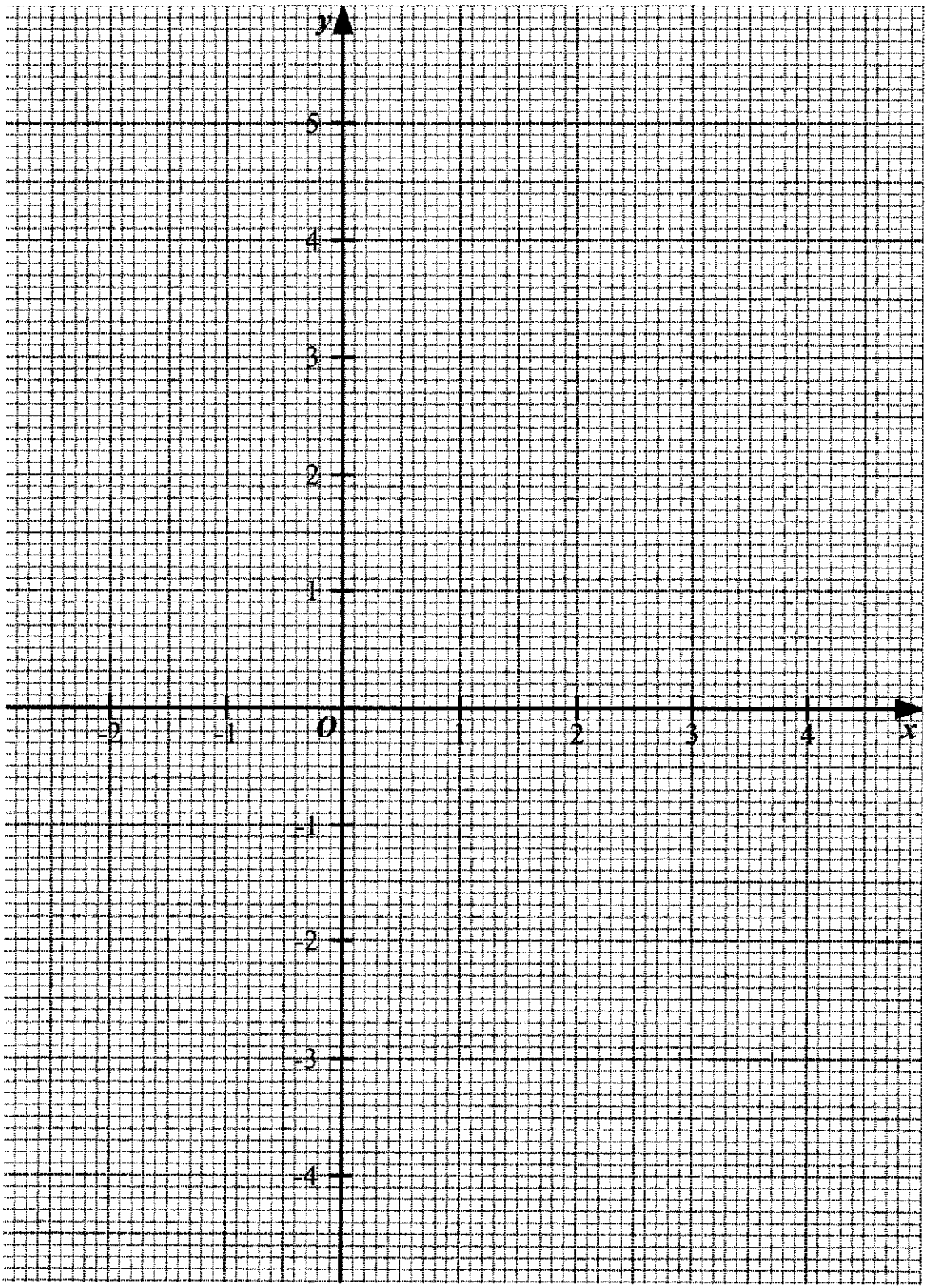
(ii) Find the equation of this tangent.

Answer ..... [2]

(d) By drawing an appropriate line, use your graph to solve the equation $\frac{1}{x-1} - \frac{1}{4}x = 0$ in the range $-2 \le x \le 4$.

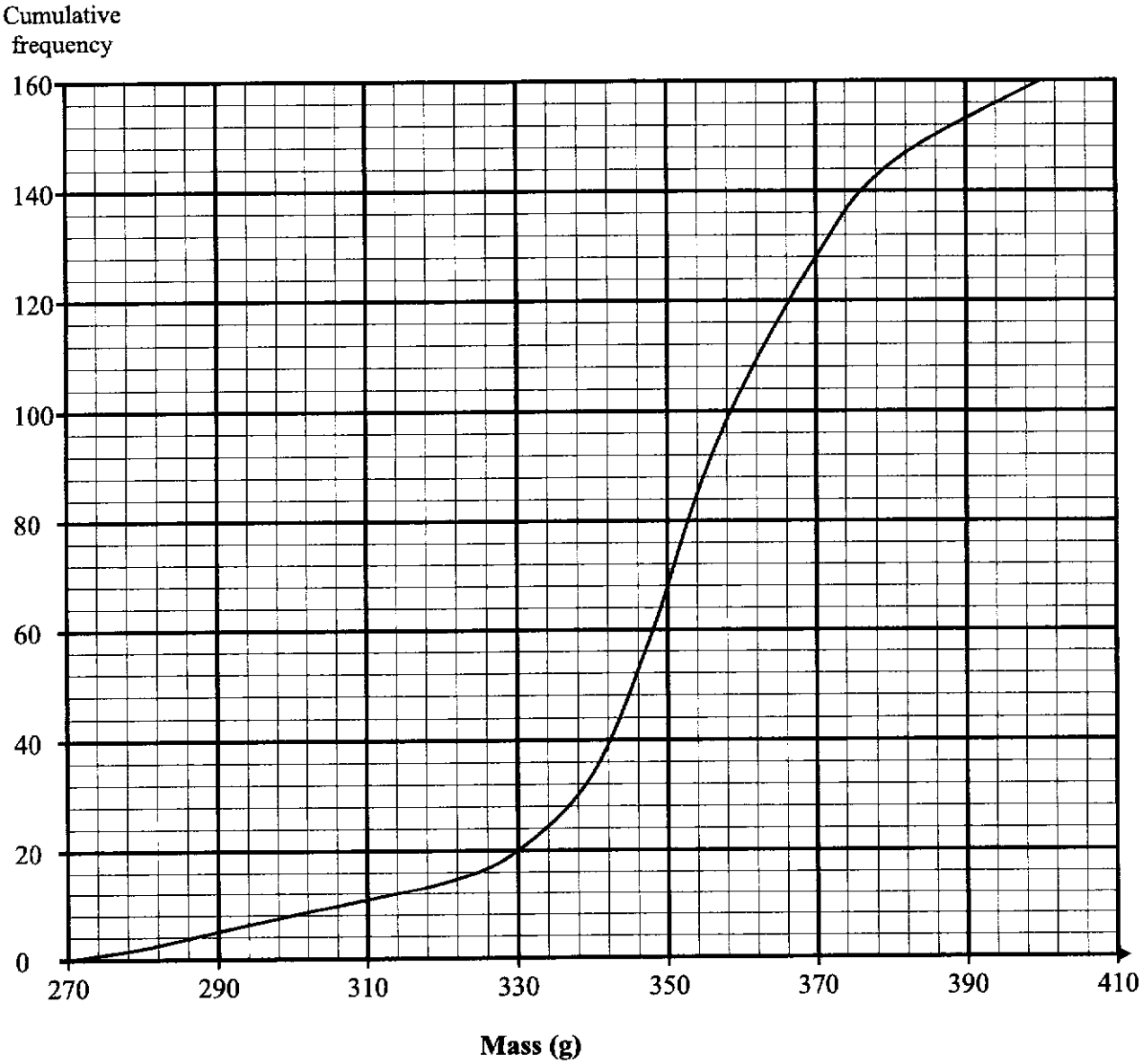
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Answer $x =$ ..... [3]



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7 The cumulative frequency curve shows the distribution of the masses of 160 apples in tree A.



(a) Use the curve to estimate

(i) the median mass,

Answer ..... g [1]

(ii) the interquartile range of the masses.

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Answer ..... [2]
g

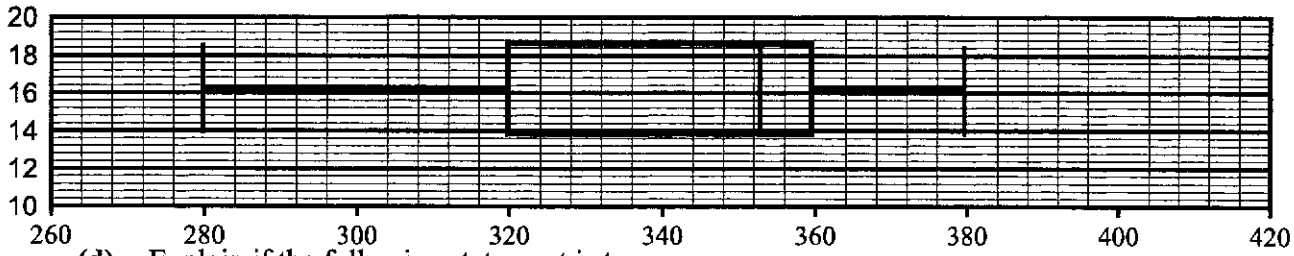
(b) 20% of the heaviest apples belong to the top grade.
Find the minimum mass an apple needs to be in the top grade.

Answer ..... [2]
g

(c) Two apples are chosen at random.
Find the probability that one apple weighs less than 320 g and the other apple weighs more than 360 g.
Give your answer to 3 significant figures.

Answer ..... [2]

The masses of 160 apples from tree B were recorded.
The box-and-whisker plot shows the distribution of the masses.



(d) Explain if the following statement is true.
"In tree B, there are more apples weighing less than 320 g as compared to those weighing more than 360 g."

.....

..... [1]

(e) Justine claims that it is better to get the apples from tree B.
Do you agree?
Explain your answer using appropriate figures.

.....

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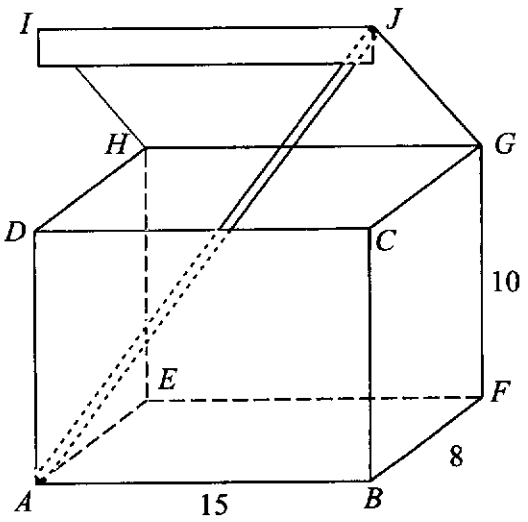
.....

.....

..... [2]

8 The diagram shows a box in the shape of a cuboid measuring 15 cm by 8 cm by 10 cm.
The box has an open lid such that I and J are vertically above the midpoints of DH and CG respectively.

A rod is placed inside the box such that it touches the box only at A and J.
Assume that the rod has negligible width.



(a) Find the length of BE.

Answer ..... [2]
cm

(b) Find the length of AG.

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Answer ..... [2]
cm

(c) Show that the length of the rod, AJ, is 22.97 cm, correct to 4 significant figures.

Answer

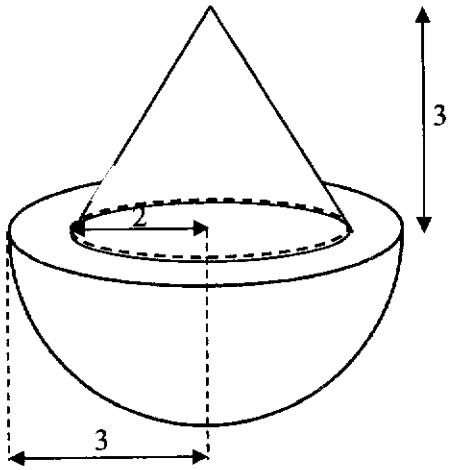
[4]

(d) Find angle JAG.

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Answer ..... ° [2]

9 An upright container is in the shape of a cone, mounted on a hemisphere.
The centre of the base of the cone and the hemisphere coincides.
The cone has a radius of 2 m and height of 3 m.
The hemisphere has a radius of 3 m.



(a) Find the capacity of the container.

Answer ..... m^3 [2]

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(b) There is a tap on the vertex of the cone.
The container is filled with water such that the hemisphere and 90% of the cone are filled.
Find the area which the water is in contact with the container.

Answer ..... m^2 [5]

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10 Tay is part of a student committee organizing a charity race event in 2025.
He wants to estimate the cost per participant to cover all expenses.

He did some more research and found the following costs.

Costs (excluding 9% GST)		
Item	Description	Unit cost
Printing of T-shirts	One sided print Bundle of 100 pcs Double sided print Bundle of 100 pcs Bundle of 500 pcs	 $800 $1500 $7000
Goodie bags (Pack of 5)	One pack of 5 bags Bulk price (100+ packs) Bulk price (500+ packs)	$20 $18 $15
Booking of venue	At least 6 months in advance 3 to 5 months in advance	$1200 $1500
Refreshments	Large set Regular set Small set	$3 $2.80 $2.50
Participant medals	Pack of 10 Pack of 50	$45 $210

The T-shirts are printed overseas and shipped by a local courier.
Tay estimated the weight of each shirt to be 140 grams and he needs to select one of the local couriers.
The shipping rate depends on the weight of the product and courier.

Local Courier	First kg	Next 0.5 kg	Weight Limit of each parcel*
Simply Post	$4.80	$1.85	80 kg
Singapore Post	$6.00	$1.80	50 kg
DPEX	$5.50	$1.60	30 kg

**Products need to be shipped in separate parcels if weight exceeds the limit.*
9% GST is applicable for import goods as well as shipping fees.

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(a) How many percent more will Tay need to pay if he booked the venue 3 months in advance instead of 6 months in advance?

Answer ..... % [1]

(b) For a 50 kg purchase, calculate the amount of shipping fees charged by Singapore Post.

Answer $ ..... [2]

The event is scheduled to be in October.
Tay estimated the number of participants to be 1000 and he plans to confirm the venue by February.
He also wants to print double sided for the participant's T-shirt, and issue a goodie bag, refreshment and medal to each participant.

He needs to decide how much registration fee he should charge each participant.
He must be able donate at least 40% of the proceeds to the charity and still cover all the costs.

(c) Suggest a sensible amount for the registration fee of a participant.
State your assumptions and decisions if any.
Show your calculations clearly.

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Answer $ ..... [7]

End of Paper

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Broadrick Secondary School

4E5N Preliminary Examination 2024

Paper 1 Marking Scheme

1	-0.17898 = -0.1790 (4sf)	B1
2a	Mean = $\frac{228}{100}$ = 2.28 s	B1
b	$\sqrt{\frac{601}{100}-(2.28)^2}$ = 0.901 s (3sf)	B1
3	$\frac{5^x}{2^{2x}\times 5^{3-x}} = 2^m 5^n$ $2^{-2x}5^{x-(3-x)} = 2^m 5^n$ $m=-2x$ $n=2x-3$	 B1 B1
4	HCF $=18=2\times 3^2$ LCM $=324=2^2\times 3^4$ X = $2^2\times 3^2$ = 36 Y = 2×3^4 = 162	 B1 B1
5a	1 : 50 000 1cm: 0.5 km Actual dist = 7.5×0.5=3.75 km	 B1
b	1cm: 0.5 km 1 cm²: 0.25 km² Area on map = $2.25\div 0.25$=9 cm²	 M1 A1
6	Largest density = largest mass/smallest vol = $\frac{115.49}{5.5}=\frac{115.5}{5.5}$ = 21 g/ cm³	 M1 A1
7	$n=3$ or 5 (any odd integer more than 1) $-1=(1)^3+b$ $b=-2$	B1 B1
8a	$\frac{\sin\angle ACB}{14.6}=\frac{\sin 31}{7.6}$ $\angle ACB=81.6562$ Obtuse $\angle ACB=180-81.6562=98.3438$ =98.3° (1dp)	M1 A1

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b	Angle ABC = $\angle ACB = 180-31-98.3438$ =50.6562 Area = $\frac{1}{2}(14.6)(7.6)\sin(50.6562)$ =42.9 cm² (3sf)	M1 (formula to find area with their angle) A1
9	In Singapore: Amount of Yen = $\frac{850}{100}\times 11600 = 98600$ In Japan Amount of Yen = $\frac{850}{0.0086}\times 1 = 98837.21$ $98837.21 > 98600$ Her claim is not true. She will receive (237.21 Yen) more if she changes in Japan.	M1 M1 A1
10a	The vertical axis did not start from 0. (Optional: The scores in 2022 looked like it had increased to 6 times but the increase was from 55 to 80 (which is slightly less than double.)	B1
b	I disagree. Although the increase in the height of the bar looks the same from 2022 to 2024 for both classes, the scale of the two graphs are different. It exaggerates the increase in test scores of Class B.	B1
11	$2^p \times 5^q \times \frac{5}{2}$ -- perfect cube (powers are multiples of 3) $p = 4$ $q = 2$	B1 B1
12a	$(16y^3)^{\frac{3}{2}} = 64y^{\frac{9}{2}}$	B1
b	$5^k = 125\sqrt[3]{5\sqrt{5}}$ $5^k = 5^3\left(5(5)^{\frac{1}{2}}\right)^{\frac{1}{3}}$ $5^k = 5^3\left(5^{\frac{3}{2}}\right)^{\frac{1}{3}}$ $5^k = 5^3\left(5^{\frac{1}{2}}\right)$ $k = 3\frac{1}{2}$	M1 (change either to power of 3) M1 (combine to $5^{\frac{1}{2}}$ or to a single power of 3) A1

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13a	A={2,3,4,6,8,12}	B1
b	Since $p \le x < 20$, B={…,11, 13, 17, 19} C={…,9, 16} $(B \cup C) = \{...,9,11,13,16,17,19\}$ $(B \cup C)' = \{12,14,15,18\}$	 B1
c	A={2,3,4,6,8,12} C={4,9,16} If $A \cap C = \varnothing$, smallest p = 5	 B1
14	$X = \frac{7-5}{5} \times 100\%$ = 40%	M1 A1
15	In triangle *OAP* and *BPA*, * $\angle OPA = \angle BAP$ (alt angle, *AB // OP*) Since *OA* = *AP* = *PB* (same radius). * $\angle AOP = \angle PBA$ (base angles of isos triangle) **AP* = *PA* (common side) Therefore $\Delta OPA \equiv \Delta BAP$ (AAS) Hence *AB* = *OP*	 B2 (any 2 of the 3 stmts) A1 (conclude AAS and equal sides)
16a	$2y = -4x + 1$ AB: $y = -2x + \frac{1}{2}$ $4y = -9x + 2$ PQ: $y = -\frac{9}{4}x + \frac{1}{2}$ The gradient of *PQ* should be steeper than that of *AB*. Hence she is not correct.	M1 (rearrange to find gradient of either line) A1 (compare both gradient and conclude)

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bi	$y=(x+4)(x-1.5)$ $y=x^2+2.5x-6$	M1 A1
bii	Min point (-1.25, -7.5625)	B1, B1
17	$\frac{2x}{3x-1}-\frac{4}{2x+1}$ $=\frac{2x(2x+1)-4(3x-1)}{(3x-1)(2x+1)}$ $=\frac{4x^2+2x-12x+4}{(3x-1)(2x+1)}$ $=\frac{4x^2-10x+4}{(3x-1)(2x+1)}$	M1 A1
18ai	$24a^2b+12ab^2-ab$ $=ab(24a+12b-1)$	B1
aii	$mn-18-9m+2n$ $=mn-9m+2n-18$ $=m(n-9)+2(n-9)$ $=(m+2)(n-9)$	M1 (grouping) A1
b	$(-2x+3q)(x-2q)$ $=-2x^2+4xq+3qx-6q^2$ $=-2x^2+7xq-6q^2$	M1 A1
19a	$A=P(1+\frac{r}{100})^n$ $=20000\left(1+\frac{0.3}{100}\right)^{24}$ =21490.79038 = \$21490.79 (2dp)	 M1 A1
b	$A=\frac{4A}{5}(1+\frac{r}{100})^{36}$ $\frac{5}{4}=(1+\frac{r}{100})^{36}$ $\sqrt[36]{\frac{5}{4}}=1+\frac{r}{100}$ $\sqrt[36]{\frac{5}{4}}-1=\frac{r}{100}$ r = 0.622%	M1 A1
20		

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	$\frac{2x^2-5xy-12y^2}{x^2-16y^2}$ $=\frac{(x-4y)(2x+3y)}{(x+4y)(x-4y)}$ $=\frac{2x+3y}{x+4y}$	M1, M1 A1
21a	$PQ=\sqrt{(-3-3)^2+(1-3)^2}$ = 6.32 units (3sf)	M1 A1
b	*R* is (1, −3) By sketching and counting, From Q to P: horizontally -6 and vertically -2 Since y=x is reflection line, From Q to R: horizontally -2 and vertically -6	B1
22	Int angle of pentagon $=\frac{(5-2)\times 180}{5}=108°$ Int angle of square = 90° Interior angle of regular polygon = $360-90-108=162°$ Exterior angle = $180-162=18°$ $n=\frac{360}{18}=20$ Since n is a positive integer, it is possible to form a regular polygon, hence a closed loop.	M1 M1 (int or ext of polygon) A1
23a	$\pi r^2 h=4\left(\frac{2}{3}\pi\left(\frac{1}{2}r\right)^3\right)$ $\pi r^2 h=\frac{8}{3}\pi\left(\frac{1}{8}r^3\right)$ $h=\frac{8}{3}\left(\frac{1}{8}r\right)$ $h=\frac{1}{3}r$	M1, M1 A1
b		M1

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	$\frac{4}{9}=\left(\frac{H}{h}\right)^2$ $\frac{H}{h}=\frac{2}{3}$ $H=\frac{2}{3}h=\frac{2}{3}\left(\frac{1}{3}r\right)$ $H=\frac{2}{9}r$	A1
24a	$5n^2-n=n(5n-1)$ When n is odd, 5n is odd and 5n-1 is even Since product of odd and even number is always even, $n(5n-1)$ is even. When n is even, 5n is even and 5n-1 is odd. Since product of odd and even number is always even, $n(5n-1)$ is even. Hence the sum of the first *n* terms in the sequence is always even.	M1 A1
b	1st term: $5(1)^2-1=4$ 2nd term: $5(2)^2-2-4=14$ 3rd term: $5(3)^2-3-14-4=24$ Therefore nth term = $10n-6$	M1 A1
25a	$P=\begin{pmatrix}4 & 3 & 2\\ 2 & 0 & x\end{pmatrix}$	B1
b	$\mathbf{R}=\mathbf{PQ}=\begin{pmatrix}4 & 3 & 2\\ 2 & 0 & x\end{pmatrix}\begin{pmatrix}8 & -1.1\\ 10 & -2.8\\ 11.5 & 1.5\end{pmatrix}$ $=\begin{pmatrix}85 & -9.8\\ 16+11.5x & -2.2+1.5x\end{pmatrix}$	B2 (B1 for any 2 correct)
c	It represents the amount of money Kevin and Molly spent respectively at Bookstore A.	B1
d	$-2.2+1.5x=5.3$ $x=5$	B1

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26a	1.5 km/min $= \frac{1.5\times1000}{1\times60}$ =25 m/s	B1
b	Area = dist travelled $21=\frac{1}{2}(v+1.5)(20)$ $21=10(v+1.5)$ $2.1=v+1.5$ $v=0.6$	M1 A1
c	$\frac{speed-0.6}{12}=\frac{1.5-0.6}{20}$ $\frac{speed-0.6}{12}=0.045$ $speed=1.14km/\min$ = 19m/s OR $acc=\frac{1.5-0.6}{20}=0.045$ $speed=0.6+12(0.045)=1.14km/\min=19m/s$	M1 A1
d	Area = dist travelled $92.25=\frac{1}{2}(0.6+1.5)(20)+1.5(40)+\frac{1}{2}(t)(1.5)$ $92.25=21+60+0.75t$ $11.25=0.75t$ $t=15\min$ T is 0915	M1 A1
27a	$3\overrightarrow{BD}=2\overrightarrow{DC}$ $\frac{BD}{DC}=\frac{2}{3}$ $\overrightarrow{AD}=\overrightarrow{AB}+\overrightarrow{BD}$ $=\mathbf{m}+\frac{2}{5}\overrightarrow{BC}$ $=\mathbf{m}+\frac{2}{5}(-\mathbf{m}+\mathbf{n})$ $=\frac{3}{5}\mathbf{m}+\frac{2}{5}\mathbf{n}$	 M1 A1
bi		

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	$\overrightarrow{AR} = k\overrightarrow{AD} = \frac{3}{5}k\mathbf{m} + \frac{2}{5}k\mathbf{n}$ $\overrightarrow{BR} = \overrightarrow{BA} + \overrightarrow{AR}$ $= -m + \frac{3}{5}k\mathbf{m} + \frac{2}{5}k\mathbf{n}$ $= \left(\frac{3}{5}k - 1\right)\mathbf{m} + \frac{2}{5}k\mathbf{n}$ Since AC is parallel to BR and $\overrightarrow{AC} = \mathbf{n}$ $\frac{3}{5}k - 1 = 0$ $k = \frac{5}{3}$	M1 M1 A1
bii	$\frac{\text{Area of triangle } ABD}{\text{Area of triangle } RBD} = \frac{AD}{DR}$ $\frac{3}{2}$	A1

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Broadrick Secondary School

4E5N Preliminary Examination 2024

Paper 2 Marking Scheme

1a	4.2×10^6	B1
b	$\frac{4.2\times10^6-3.6\times10^6}{3.6\times10^6}\times100\%$ $=16\frac{2}{3}\%$	M1 A1
c	$\frac{3.6\times10^6}{100-4}\times100\%$ = 3750000 $=3.75\times10^6$	M1 A1
2a	$12x-8x^2=6-8x^2$ $12x=6$ $x=\frac{1}{2}$	M1 A1
b	$1-3p\geq5$ $-3p\geq4$ $p\leq-\frac{4}{3}$	B1
c	$3A=\frac{Ap+h}{1-h}$ $3A(1-h)=Ap+h$ $3A-3Ah=Ap+h$ $3A-3Ah-Ap=h$ $A(3-3h-p)=h$ $A=\frac{h}{3-3h-p}$	M1 (make linear) M1 (Factorise) A1
d		M1 (combine) M1 (expand)

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	$\frac{x}{(x-4)^2}-\frac{3}{4-x}=2$ $\frac{x}{(x-4)^2}+\frac{3}{x-4}=2$ $\frac{x+3(x-4)}{(x-4)^2}=2$ $x+3x-12=2(x^2-8x+16)$ $4x-12=2x^2-16x+32$ $0=2x^2-20x+44$ $0=x^2-10x+22$ $x=\frac{-(-10)\pm\sqrt{(-10)^2-4(1)(22)}}{2(1)}$ $=\frac{10\pm\sqrt{12}}{2}$ = 6.73 or 3.27 (2dp)	M1 (quadratic formula using their found eqn) A1
3a	$3y+5x-6=0$ $y=-\frac{5}{3}x+2$ $-1=-\frac{5}{3}(-3)+c$ $c=-6$ $y=-\frac{5}{3}x-6$	M1 (find m) M1 A1
b	$y=-\frac{5}{3}(0)-6=-6$ $B(0,-6)$ Mid point of BD = $(0, \frac{9+-6}{2})$ = (0, 1.5) C is (x, 1.5) and sub into $y=7.5-x$ $1.5=7.5-x$ $x=6$ So C is (6, 1.5)	M1 (find y value of C) A1
c	Area = $\frac{1}{2}(15)(3)+\frac{1}{2}(15)(6)$	M1 A1 (ECF from

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	=67.5	(b))
d	Let P be (0,-1). $\tan \angle ABP = \frac{3}{5}$ $\angle ABP = \tan^{-1}\left(\frac{3}{5}\right)$ Let Q be (0,1.5). $\tan \angle CBQ = \frac{6}{7.5}$ $\angle CBQ = \tan^{-1}\left(\frac{6}{7.5}\right)$ $\angle ABC = \tan^{-1}\left(\frac{3}{5}\right) + \tan^{-1}\left(\frac{6}{7.5}\right)$ = 69.6° Or find length of AB, BC and AC and use cosine rule.	M1 M1 A1
4a	20	B1
bi	$X = pn^2 + qn$ When n = 4 and X=2, $2 = p(4)^2 + q(4)$ $2 = 16p + 4q$ When n = 5 and X=5, $5 = p(5)^2 + q(5)$ $5 = 25p + 5q$	 A1 A1
bii	$16p + 4q = 2$ $80p + 20q = 10$ ----(1) $25p + 5q = 5$ $100p + 20q = 20$ ----(2) (2)-(1) $20p = 10$ $p = 0.5$ $q = -1.5$	 M1 A1 A1
biii		M1

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	$495 = 0.5n^2 - 1.5n$ $0 = -495 - 1.5n + 0.5n^2$ $0 = n^2 - 3n - 990$ $(n-33)(n+30) = 0$ $n = 33$ or $n = -30$ (rej) Since number of vertices is an integer, it is possible to have a *n*-sided polygon with 495 diagonals.	M1 A1
5ai	$\angle ABC = \frac{100}{2} = 50°$ *(angle at centre = 2x angle at circumference)*	B1
aii	$\angle ADC = 180° - 50° = 130°$ *(angles in opp seg)*	B1
aiii	$\angle ACO = \frac{180° - 100°}{2} = 40°$ *(base angles of isos triangle)* $\angle COT = 40°$ *(alt angles, AC//OT)* $\angle OCT = 90°$ *(tan perpendicular to rad)* $\angle OTC = 180° - 90° - 40° = 50°$ *(angle sum of triangle)*	M1 M1 A1
b	$\angle ADC + \angle AOC = 130° + 100°$ $= 230°$ $\neq 180°$ They are not angles in opposite segment. A circle cannot be drawn passing through the points *A*, *O*, *C* and *D*.	B1
c	$\tan 50° = \frac{OC}{4.8}$ $OC = 5.72042$ Minor segment = minor sector – triangle $= \frac{100}{360} \times \pi (5.72042)^2 - \frac{1}{2}(5.72042)^2 \sin(100°)$ =12.4 cm²	M1 M1 A1
6a	-3.33 (2dp)	B1
6b	All points plotted correctly Smooth curve	P2 C1
6ci	Tangent drawn such that it passes through (-1,2) and touches curve at 1 point and gradient is negative.	C1
6cii	$m = \frac{2-(-1)}{-1-0} = -3$ $c = -1$ $y = -3x - 1$	M1 A1
6d		

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	$\frac{1}{x-1}-\frac{1}{4}x=0$ $\frac{1}{x-1}-\frac{1}{4}x+\frac{5}{4}x-1=\frac{5}{4}x-1$ $y=\frac{5}{4}x-1$ Draw line on graph x = 2.6 and -1.5 (accept 2.5, 2.55) (accept -1.4, -1.45, -1.55, -1.6)	M1 M1 A1
7ai	Median = 353 g	B1
aii	UQ: 366 or 367 LQ: 342 or 343 IQR = $366-342$ = 24g (also accept 23 or 25 g depending on their UQ & LQ)	 M1 A1
b	20%–>32 apples Read at 128th apple Min mass = 370 g	M1 A1
c	$\frac{14}{160}\times\frac{160-104}{159}\times 2$ = 0.0616	M1 A1
d	False. The first quartile which represents 25% of the apples are less than 320g. The upper quartile which represents 75% of the apples are less than 360g which implies that 25% of the apples are more than 360g Hence there are equal number of apples weighing less than 320g and more than 360g.	 B1 (states that the whiskers rep 25% of the data)
e	I disagree. The median mass of apples from tree A is the same as that from tree B. On average, apples from tree A and B weigh the same. IQR (Tree B) = 360 – 320 = 40g However, the interquartile range of the masses of the apples from tree B is bigger than that from tree A. The masses of the apples from tree B have a bigger spread, thus are less consistent.	 B1 B1

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8a	$BE = \sqrt{15^2 + 8^2}$ = 17 cm	M1 A1
b	$AG = \sqrt{17^2 + 10^2} = \sqrt{389}$ = 19.7 cm (3sf)	M1 A1
c	Let *M* be the midpoint of *CG* and *N* be the midpoint of *BF*. $JM = \sqrt{8^2 - 4^2} = \sqrt{48}$ Then $JN = 10 + \sqrt{48}$ $AN = \sqrt{15^2 + 4^2} = \sqrt{241}$ $AJ^2 = (\sqrt{241})^2 + (10 + \sqrt{48})^2$ $AJ = 22.96876$ = 22.97 (4sf) (shown)	M1 M1 M1 A1
d	$\cos \angle JAG = \dfrac{22.97^2 + \left(\sqrt{389}\right)^2 - 8^2}{2 \times 22.97 \times \sqrt{389}}$ $\angle JAG = 19.7796$ =19.8° (1dp) If use exact value, angle =19.78165 = 19.8° (1dp)	M1 A1
9a	Capacity = $\dfrac{1}{3}\pi(2)^2(3) + \dfrac{2}{3}\pi(3)^3$ =69.1150 = 69.1 m³	M1 A1
b	Curved hemisphere = $2\pi(3)^2 = 18\pi$ Ring = $\pi(3)^2 - \pi(2)^2 = 5\pi$ Slant height of cone, L = $\sqrt{2^2 + 3^2} = \sqrt{13}$ Curved area of big cone = $\pi(2)\sqrt{13} = 2\pi\sqrt{13}$ Using similar solids, $\dfrac{h_{\text{small cone}}}{h_{\text{big cone}}} = \sqrt[3]{\dfrac{1}{10}}$ $\dfrac{A_{\text{small cone}}}{A_{\text{big cone}}} = \left(\sqrt[3]{\dfrac{1}{10}}\right)^2 = \dfrac{1}{\sqrt[3]{100}}$ $\dfrac{A_{\text{contact with water}}}{A_{\text{big cone}}} = \dfrac{\sqrt[3]{100} - 1}{\sqrt[3]{100}}$ $A_{\text{contact with water}} = \dfrac{\sqrt[3]{100} - 1}{\sqrt[3]{100}} \times 2\pi\sqrt{13} = 17.7736$ Total area in contact = $18\pi + 5\pi + 17.7736$	M1 (Hemisphere or ring) M1 (CSA of big cone using their L) M1 (find ratio of h and then area) M1 (find area of cone in contact)

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<table>
<tr><td></td><td>= 90.0302 = 90.0 m²</td><td>A1</td></tr>
<tr><td>10a</td><td>$\frac{300}{1200}\times 100\% = 25\%$</td><td>B1</td></tr>
<tr><td>b</td><td>$6+1.8\times 2\times 49 = \$182.40$</td><td>M1, A1</td></tr>
<tr><td>c</td><td>
<table>
<tr><th>Item</th><th>Description</th><th>Total cost</th></tr>
<tr><td>Printing of T-shirts</td><td>Double side (Bundle of 500 pcs)</td><td>$7000 x 2= $14000</td></tr>
<tr><td>Goodie Bags</td><td>No of packs req = 1000/5 = 200

Bulk price (100+ packs)</td><td>

$18 x 200 = $3600</td></tr>
<tr><td>Booking of venue</td><td>6 months in advance</td><td>$1200</td></tr>
<tr><td>Refreshments</td><td>Large set

Regular set

Small set</td><td>$3 x 1000 = $3000
or
$2.80 x 1000 = $2800
or
$2.50 x 1000 = $2500</td></tr>
<tr><td>Participants medals</td><td>Number of pack of 50 = 1000/50 = 20</td><td>$210 x 20 = $4200</td></tr>
</table>

Total weight of shirts = 140 g x 1000 = 140 kg

<table>
<tr><th>Local Courier</th><th>Number of parcels</th><th>Cost</th></tr>
<tr><td>Simply Post</td><td>$\frac{140}{80}\approx 2$
1 parcel of 80 kg + 1 parcel of 60 kg</td><td>$(4.80+1.85\times 2\times 79)$
$+(4.80+1.85\times 2\times 59)$
$=520.20$</td></tr>
<tr><td>Singapore Post</td><td>$\frac{140}{50}\approx 3$
2 parcels of 50 kg + 1 parcel of 40 kg</td><td>$2(6+1.80\times 2\times 49)$
$+(6+1.80\times 2\times 39)$
$=511.20$</td></tr>
<tr><td>DPEX</td><td>$\frac{140}{30}\approx 5$
4 parcels of 30 kg + 1 parcel of 20 kg</td><td>$4(5.5+1.60\times 2\times 29)$
$+(5.5+1.60\times 2\times 19)$
$=727.60$</td></tr>
</table>

Choose Singapore Post & Large Set of refreshment.

Total costs after GST =

$(14000+3600+1200+3000+4200+511.20)\times\frac{109}{100}$
</td><td>M1 (T-shirt printing)

M1 (bag)

M1 (medals)

M1 (shipping)

M1 (cost after GST)</td></tr>
</table>

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	=28897.208 At least 40% to charity, so 60% will be to cover costs: Including charity = $28897.208 \times \frac{100}{60} = 48162.01$ Fee for each participant= $\frac{48162.01}{1000} = \$48.16$ To donate at least 60% of the proceeds and cover all costs, sensible amount to charge each participant = $50.	M1 (total including charity) A1

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