Name:	Index No.:	Class:

PRESBYTERIAN HIGH SCHOOL

MATHEMATICS
PAPER 1

4052/01

19 August 2025 Tuesday 2 hours 15 minutes

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2025 SECONDARY FOUR EXPRESS / FIVE NORMAL
PRELIMINARY EXAMINATION

DO NOT OPEN THIS QUESTION PAPER UNTIL YOU ARE TOLD TO DO SO.

INSTRUCTIONS TO CANDIDATES:

Write your name, index number and class on the spaces provided above.
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.
Note that all the diagrams in this paper are not drawn to scale.

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				
Category	Accuracy	Notations	Others	*Marks Deducted*
Question No.				

Total Marks
90

This question paper consists of **23** printed pages (including this cover page) and **1** blank page.

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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

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

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

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Answer **all** the questions.

1 Calculate $\sqrt[3]{27.38^2 - \frac{7.9}{0.021}}$.

Answer ..... [1]

2 Simplify

(a) $4\sqrt[5]{y^6} \times y^{-1}$,

Answer ..... [1]

(b) $5x - 7 - 9x + 3x - 2$.

Answer ..... [1]

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3 **(a)** Expand and simplify $(p+2)(1+3p-p^2)$.

Answer ..... [2]

(b) Write as a single fraction in its simplest form $\frac{3}{(5-2x)^2}-\frac{1}{5-2x}$.

Answer ..... [2]

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4 **(a)** Express 504 as a product of its prime factors.

Answer ..... [1]

(b) Find the smallest positive integer value of k such that $\sqrt[3]{504k}$ is an integer.

Answer $k =$ ..... [1]

(c) The highest common factor (HCF) of two numbers is 84. The lowest common multiple (LCM) of the two numbers is 504. Both numbers are more than 100. Find the two numbers.

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

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5 It is given that x pencils cost y dollars and 4 cents.

(a) Find the cost of one pencil in cents.

Answer .....cents [1]

(b) Write down an expression for the number of pencils that could be bought for t dollars.

Answer ..... [1]

6 Given that $A:B=\frac{1}{6}:\frac{1}{5}$ and $B:C=3:7$, find $A:C$ as a ratio of two integers.

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

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7 Find the smallest integer that satisfies $6y-3>17$.

Answer ..... [2]

8 The force F, between two particles is inversely proportional to the square of the distance between them. The force is 64 units when the distance between the particles is r metres. Find the force when the distance between the particles is reduced by 20%.

Answer .....units [2]

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9 The distance between Earth and Venus is 150.4 million kilometres.

(a) Express 150.4 million in standard form.

Answer ..... [1]

(b) A space shuttle can travel 7500 metres in 1 second.

(i) Find the speed, in kilometres per hour, of the space shuttle.

Answer .....km/h [1]

(ii) Find the number of days the space shuttle will take to travel from Earth to Venus.
Give your answer to the nearest whole number.

Answer .....days [2]

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10 Given that $3a + 5c = \frac{3-c}{2b}$, make c the subject of the equation.

Answer ..... [3]

11 The scale of a map is given as 1: 50000.

(a) A road on the map is 16 cm long. Find the actual length of a road in kilometres.

Answer .....km [1]

(b) A lake has an area of 40 km^2. Find the area of the lake on the map in square centimetres.

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

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12 The frequency table shows the masses of 50 students from Class A.

Mass (m kg)	$20 < m \leq 30$	$30 < m \leq 40$	$40 < m \leq 50$	$50 < m \leq 60$	$60 < m \leq 70$
Frequency	2	11	20	12	5

(a) Calculate the mean mass of the students from Class A.

Answer .....kg [1]

(b) Calculate the standard deviation for the mass of students in class A.

Answer .....kg [1]

(c) Explain why the value of the mean calculated in **part (a)** is only an estimate.

Answer

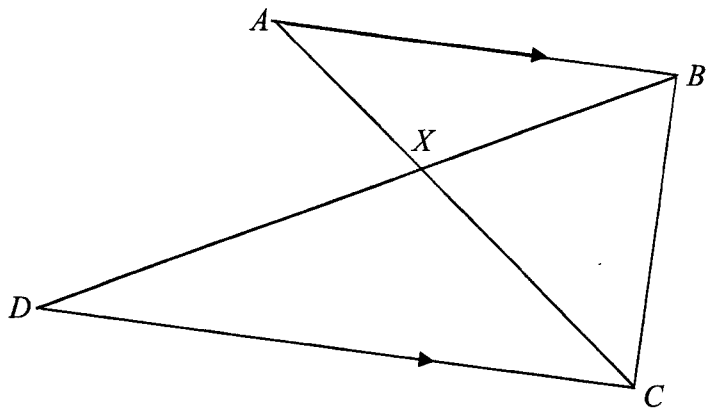
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..... [1]

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13 In the diagram, AB is parallel to DC. AC and BD meet at X.



(a) Show that triangle ABX and triangle CDX are similar.
Give a reason for each statement you make.

Answer

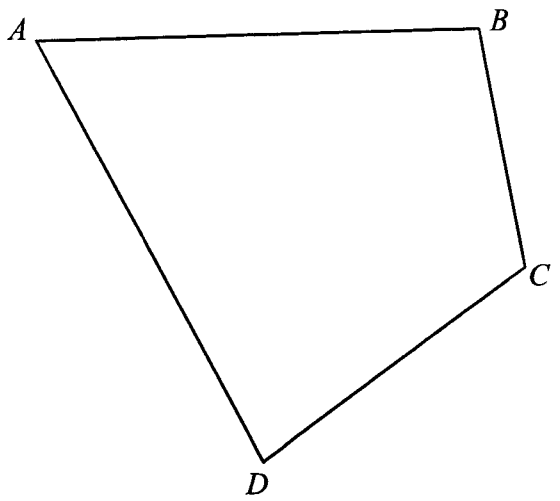
[2]

(b) $AB = 16$ cm, $AX = 8$ cm, $XC = 12$ cm.
Given that $BD = 28$ cm, find BX.

Answer BX=.....cm [2]

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14 The diagram shows a quadrilateral playground $ABCD$.



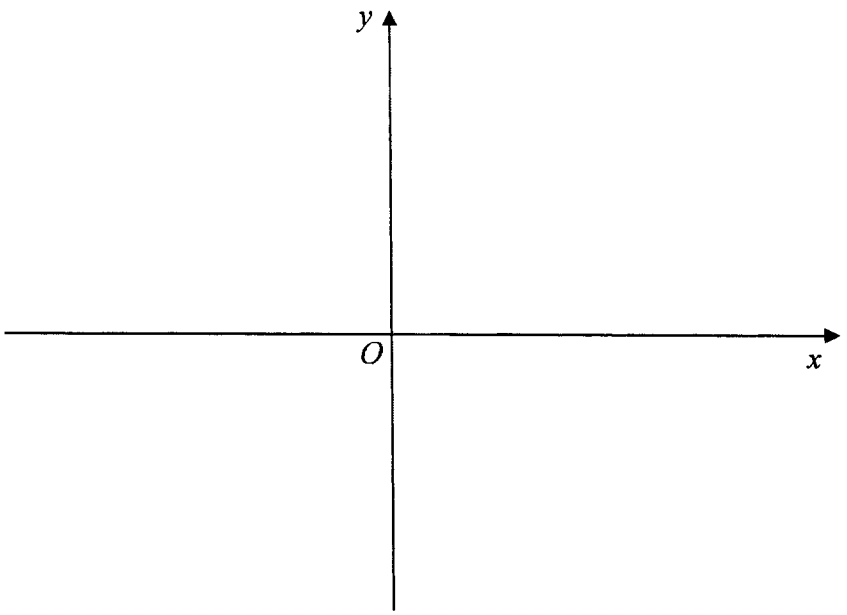
(a) Construct the perpendicular bisector of AB. [1]

(b) Construct the bisector of angle BCD. [1]

(c) Shade the region inside $ABCD$ that is closer to CD than BC and closer to B than A. [1]

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15 **(a)** Sketch the graph of $y=(x+4)(x-8)$ on the axes below.
Indicate clearly the values where the graph crosses the x and y axes.



[2]

(b) Use the graph in **part (a)** to explain whether the graph of $y=(x+4)(x-8)+26$ cuts the x-axis.

Answer

……

……

…… [1]

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16 A, B and C are points $(-4, 3)$, $(1, 9)$ and $(0, 2)$ respectively.

(a) Find the length of AB.

Answer $AB =$ ..... units [2]

(b) Find the equation of the line that passes through B and has the same gradient as AC.

Answer ..... [2]

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17 Given that $2x - y = 8$ and $xy = 4$, without solving for x and y, find the value of $4x^2 + y^2$.

Answer ..... [2]

18 Factorise completely $18ac - 8c + 27ab - 12b$.

Answer ..... [2]

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19 The first four terms in a sequence of numbers, T_1, T_2, T_3, T_4 ... are given below.

$$T_1 = 2^0 + 1$$
$$T_2 = 2^1 + 3$$
$$T_3 = 2^2 + 5$$
$$T_4 = 2^3 + 7$$
$$\vdots$$

(a) Write down T_5.

Answer ..... [1]

(b) Express T_n in terms of n.

Answer ..... [2]

(c) Hence show that $T_n - T_{n-1} = 2^{n-2} + 2$.

Answer

[2]

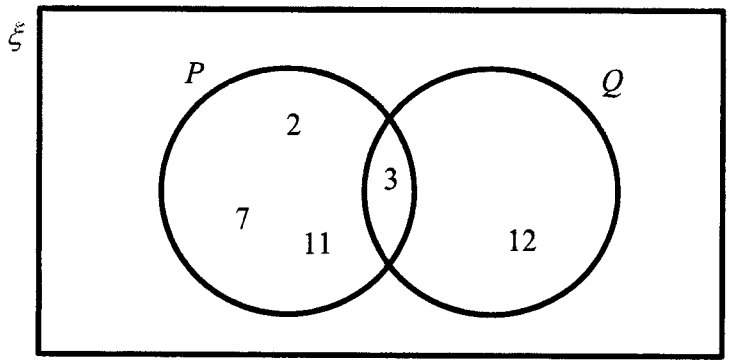
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20 $\xi = \{\text{integers } x : 1 \leq x \leq 15\}$

P = {prime numbers}

Q = {multiples of 3}

Some of the elements of P and Q have been filled in the Venn diagram.



(a) **Complete** the Venn diagram above by filling in all the missing elements. [2]

(b) List the elements in $P' \cap Q$.

Answer ..... [1]

(c) Use one of the symbols below to complete each statement.

$\varnothing \quad \in \quad \notin \quad \subset \quad \not\subset$

(i) $P \cap Q \neq$ ..... [1]

(ii) {2,3,7} ..... P [1]

(iii) 2 ..... Q [1]

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21 A bakery produces cheesecakes, fruit cakes and red velvet cakes The number of cakes sold on a particular weekend is given by the matrix **G**.

$$\mathbf{G} = \begin{matrix} \\ \text{Saturday} \\ \text{Sunday} \end{matrix} \begin{matrix} \begin{matrix} \text{cheese} & \text{fruit} & \text{red velvet} \end{matrix} \\ \begin{pmatrix} 15 & 20 & 14 \\ 12 & 18 & 10 \end{pmatrix} \end{matrix}$$

A cheesecake is sold for $\$x$, a fruit cake is sold for $\$(x-8)$ and a red velvet cake is sold for $\$(x-3)$.

(a) Represent this information in a 3×1 matrix, **J**.

Answer **J** = [1]

(b) Find in terms of x, the matrix **K = GJ**.

Answer **K** = [2]

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

.....

.....

..... [1]

(d) The total amount of money collected by the bakery from the sales of all the cakes on this particular weekend is \$5676, find the value of x.

Answer x=..... [2]

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22 Box X contains 4 balls numbered 1, 2, 3 and 4.
Box Y contains another 4 balls numbered 1, 3, 5 and 6.
In a game, May drew a ball at random from each box, and the sum of both numbers is obtained.

(a) Complete the possibility diagram below.

Box Y

Box X	+	1	3	5	6
	1	2			7
	2		5		
	3			8	
	4		**7**		10

[2]

(b) Find the probability that the sum obtained is 6.

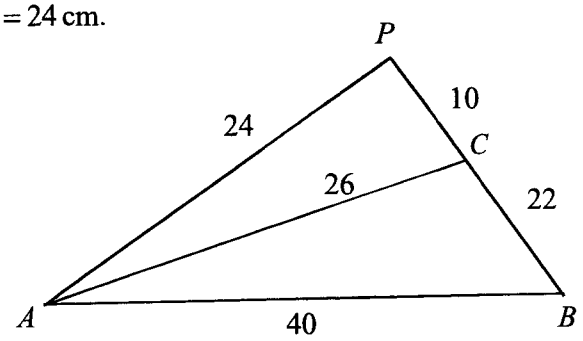
Answer ..... [1]

(c) Box Z contains 4 balls numbered 10, 20, 30 and 40. Albert drew a ball at random from each of the boxes X, Y and Z, and the sum of all three numbers is obtained.
Find the probability that the sum obtained is more than 30 but less than 36.

Answer ..... [2]

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23 In triangle ABC, $AB = 40$ cm, $BC = 22$ cm and $AC = 26$ cm. P is a point on BC produced, where $CP = 10$ cm and $AP = 24$ cm.



(a) Explain why angle APB is a right angle.

Answer

[1]

(b) Express the following as a fraction in its lowest term

(i) $\tan \angle ABP$,

Answer ..... [1]

(ii) $\cos \angle ACB$.

Answer ..... [1]

(c) A circle passes through the points A, P and B. John said that the radius of the circle is 16 cm. Do you agree with him?

.....

.....

..... [2]

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24 Eighteen students took a test.
Their scores are shown in the stem-and-leaf diagram below.

Stem	Leaf
0	3 5 8
1	0 1 2 2 3 p 6 7 7 7 9
2	1 8 8 9

Key 1|3 means 13

(a) Given that the median score is 15, find

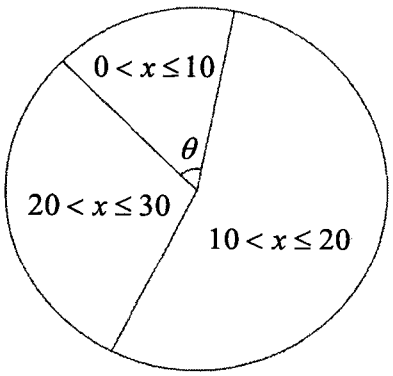
(i) the modal score,

Answer ..... [1]

(ii) the value of p.

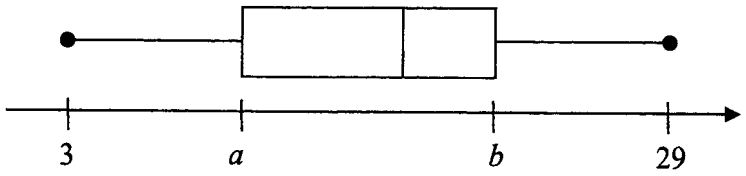
Answer ..... [1]

(b) These students are grouped into three groups based on their scores, x. This is represented on the pie chart below. Find the value of θ.



Answer θ=..... [1]

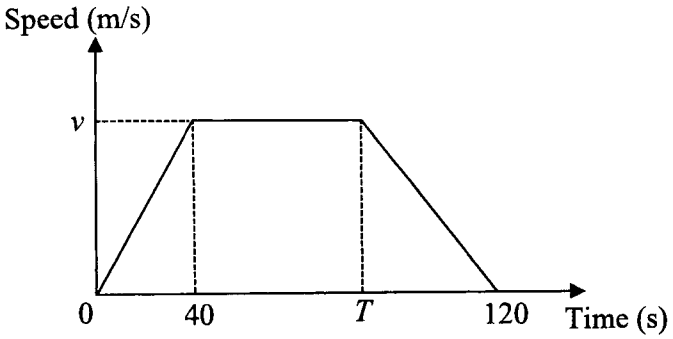
(c) The above data is represented on a box-and-whisker plot shown below.
Find the value of a and of b.



Answer a = ... b= ..... [2]

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25 The diagram below shows the speed-time graph of a bus journey.
The bus accelerated from rest at 0.5 m/s^2 to a speed of v m/s in 40 seconds, and travelled at this speed until T seconds before it came to a stop at 120 seconds.
The total distance travelled for the whole journey was 1500 m.
The area beneath the speed-time graph represents the distance travelled by the bus.



Find the value of

(a) v,

Answer v=..... [1]

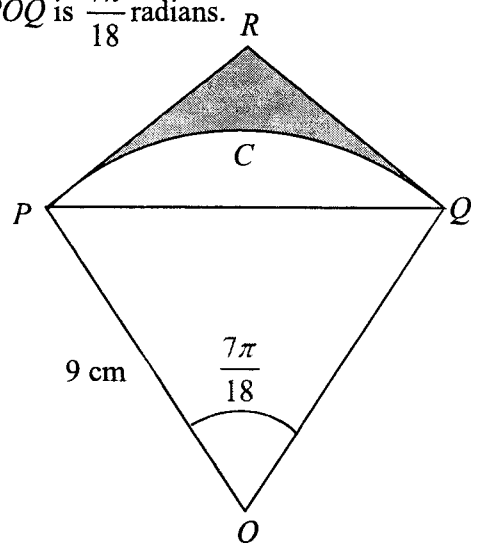
(b) T.

Answer T=..... [2]

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26 PCQ is an arc of a circle, centre O, of radius 9 cm.

The tangents at P and Q meet at R. Angle POQ is $\frac{7\pi}{18}$ radians.



(a) Show that angle $PRQ = \frac{11\pi}{18}$ radians.

Answer [1]

(b) Find the length of arc PCQ.

Answer .....cm [1]

(c) Find the area of the shaded region.

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

END OF PAPER

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PRESBYTERIAN HIGH SCHOOL

MATHEMATICS
PAPER 2

4052/02

21 August 2025 Thursday 2 hours 15 minutes

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Qn	1	2	3	4	5	6	7	8	9	10	*Marks Deducted*
Marks											

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Question			

TOTAL MARKS
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TURN OVER FOR QUESTION 1

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1 **(a)** Solve $\frac{x-3}{5}+\frac{x}{7}-1=0$.

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

(b) Simplify $\frac{10x^2}{y} \div \frac{2y^3}{x^2y}$.

Answer ..... [1]

(c) Simplify $\frac{18a^2-2}{15a^2+7a-4}$.

Answer ..... [3]

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(d) Given the equation $q^2 + 6q - 20 = 0$.

(i) Express $q^2 + 6q - 20 = 0$ in the form $(q+m)^2 + n = 0$.

Answer ..... [2]

(ii) Hence, solve for q, giving your answers correct to 2 decimal places.

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

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2 **(a)** Linus invests a sum of money at 7% per annum simple interest. At the end of n years, the amount is more than twice the initial sum of money. Find the minimum integer value of n.

Answer ..... [3]

(b) Marcus wants to invest \$12,000 for 4 years and is exploring two investment options with different compounding frequencies.

Option A	**Option B**
6.5% annual interest compounded monthly	6.8% annual interest compounded half yearly

Determine which option Marcus should choose. Justify your reasons with calculations.

Answer Option ..... [3]

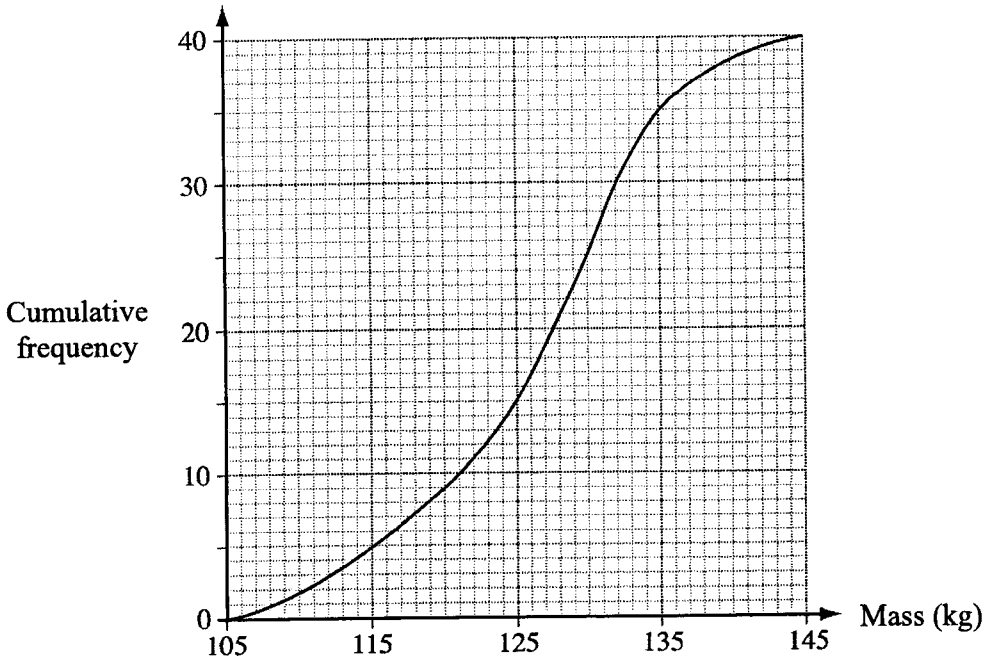
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(c) A group of students travelled to Malaysia. They exchanged Singapore dollars (SGD) to Malaysian ringgit (MYR) at a rate of SGD 1 = MYR 3.20.
They spent MYR 2525 on accommodation and food. They also bought 80 litres of fuel at MYR 2.50 per litre. They exchanged the remaining MYR at a rate of SGD 1 = MYR 3.25 and received SGD 60.
Calculate the amount of SGD they exchanged at the start of their trip.

Answer SGD..... [3]

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3 The cumulative frequency curve below shows the distribution of masses of adults **before** a weight loss programme. The programme has 40 adults.



(a) Using the graph,

(i) find the number of adults who had a mass between 115 kg and 125 kg,

Answer ..... adults [1]

(ii) estimate the 90th percentile,

Answer ..... kg [1]

(iii) calculate the interquartile range.

Answer ..... kg [2]

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(b) Two adults were selected at random before the programme. Find the probability that

(i) at least one of the two adults was heavier than 135 kg,

Answer ..... [2]

(ii) one of the two adults was heavier than 120 kg and the other was not.

Answer ..... [2]

(c) The weight of these 40 adults are taken again **after** the weight loss programme. The details are shown below:

Median	**25th percentile**	**75th percentile**
115 kg	110 kg	119 kg

Make a comparison between the before and after programme to determine if the programme is effective.

Answer

.....

.....

.....[1]

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4 **(a)** Complete the table of values for $y = \frac{3x^3}{10} - x + 1$.

x	−3	−2	−1	0	1	2	3
y	p	0.6	1.7	1	0.3	1.4	6.1

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

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

(c) The equation $k = \frac{3x^3}{10} - x + 1$ has 2 solutions in the range $-3 \le x \le 3$.
Write down the value(s) of k.

Answer $k =$ ..... [1]

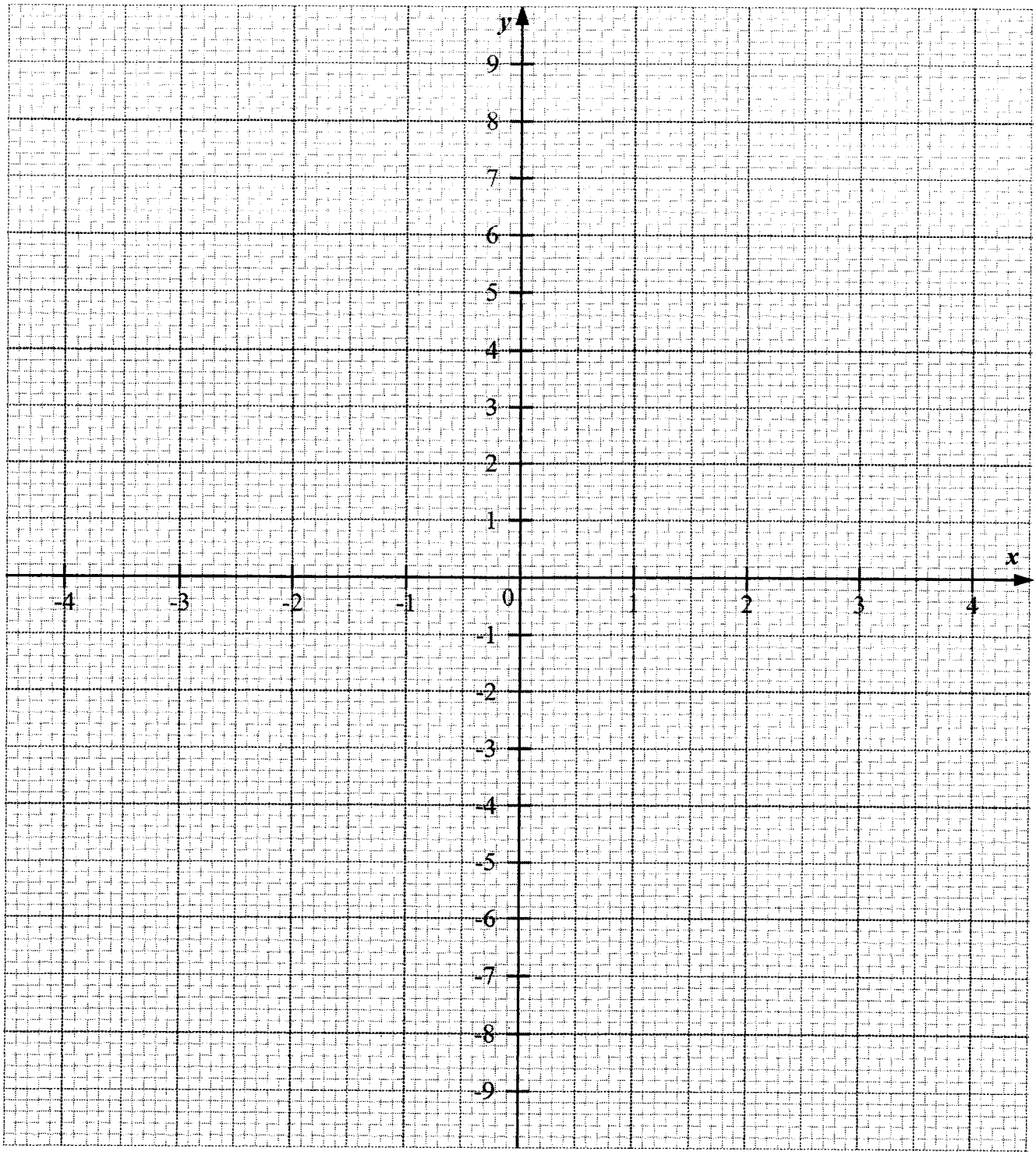
(d) By drawing a tangent, find the gradient of the curve at $x = 1.6$.

Answer ..... [2]

(e) By drawing a suitable straight line on the grid, solve the equation $3x^3 - 30x - 20 = 0$.

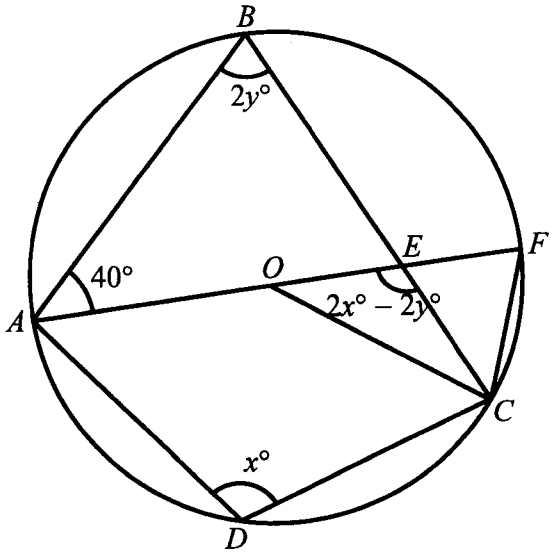
Answer $x =$ ..... [3]

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5 **(a)** In the diagram, the points A, B, C, D and F lie on the circle with centre O. AF is the diameter and CEB is a straight line, $\angle AEC = 2x° - 2y°$, $\angle ABC = 2y°$, $\angle ADC = x°$ and $\angle BAE = 40°$.



Give a reason why

(i) $x + 2y = 180$,

Answer ..... [1]

(ii) $2y + 40 = 2x - 2y$.

Answer ..... [1]

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(b) Solve the two equations in **part (a)** simultaneously.

Answer $x =$ .....

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

(c) Hence, calculate, stating reasons,

(i) $\angle AOC$,

Answer ..... [2]

(ii) $\angle ACB$.

Answer ..... [2]

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6 **(a)(i)** Each interior angle of a regular polygon is $y°$. Find the number of sides of the polygon. Give your answer in terms of y.

Answer .....° [2]

(ii) Hence, explain whether it is possible for the value of y to be 20.

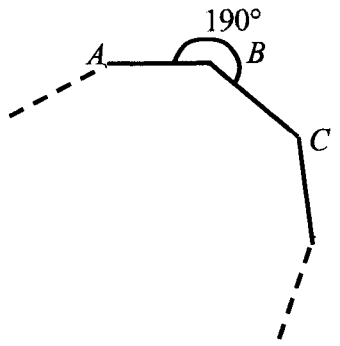
Answer

.....

.....

.....[2]

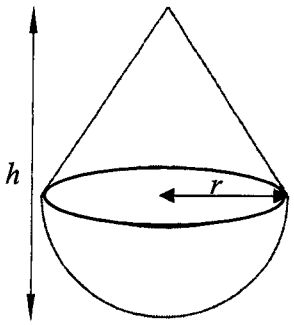
(b) A, B and C are three vertices of an n-sided polygon. Given that the reflex angle $ABC = 190°$ and all the other exterior angles are all equal to 35° each. Find n.



Answer n =..... [3]

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7 **(a)** The diagram shows a solid formed by joining a cone and a hemisphere at their circular bases. The radius of the circular base is r and the total height of the solid is h.



(i) Write an expression for the height of the cone in terms of r and h.

Answer ..... [1]

(ii) If $r = 5$ cm and $h = 12$ cm, calculate the volume of the solid, giving your answer in terms of π.

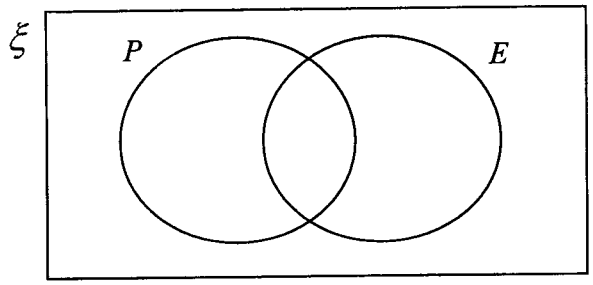
Answer ..... [2]

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(b) ξ = {all quadrilaterals}
P = {quadrilaterals with at least one pair of parallel sides}
E = {quadrilaterals with diagonals that intersect at right angles}

K is a kite.
R is a rhombus.
T is a trapezium.

On the Venn Diagram below, write K, R and T in the appropriate subsets. [2]



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8 **(a)** The point A is $(2, -3)$ and the point B is $(7, 4)$.

(i) Express $\overrightarrow{AB}$ as a column vector.

Answer ..... [1]

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

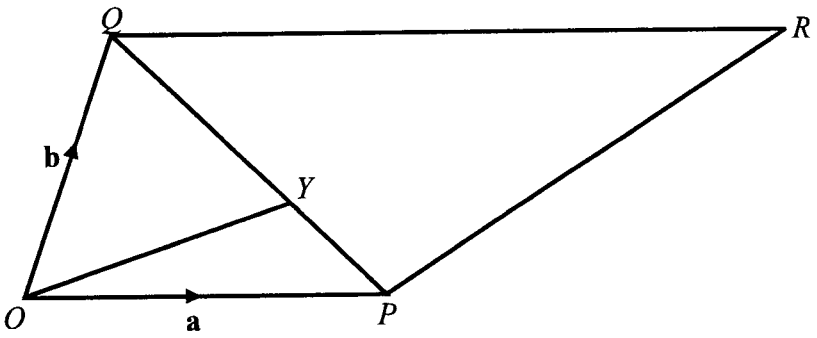
Answer ..... [2]

(iii) C is the point such that $\overrightarrow{AC} = 3\overrightarrow{AB}$.
Find the coordinates of C.

Answer (.....) [2]

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(b)



In the diagram, $\overrightarrow{OP} = \mathbf{a}$, $\overrightarrow{OQ} = \mathbf{b}$, $\overrightarrow{PY} = \frac{1}{3}\overrightarrow{PQ}$ and $\overrightarrow{QR} = 2\overrightarrow{OP}$.

(i) Express each of the following in terms of **a** and **b**.

(a) $\overrightarrow{OR}$

Answer ..... [1]

(b) $\overrightarrow{PY}$

Answer ..... [1]

(c) $\overrightarrow{OY}$

Answer ..... [1]

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(ii) What can you deduce about O, Y and R? Explain.

Answer

.....

.....

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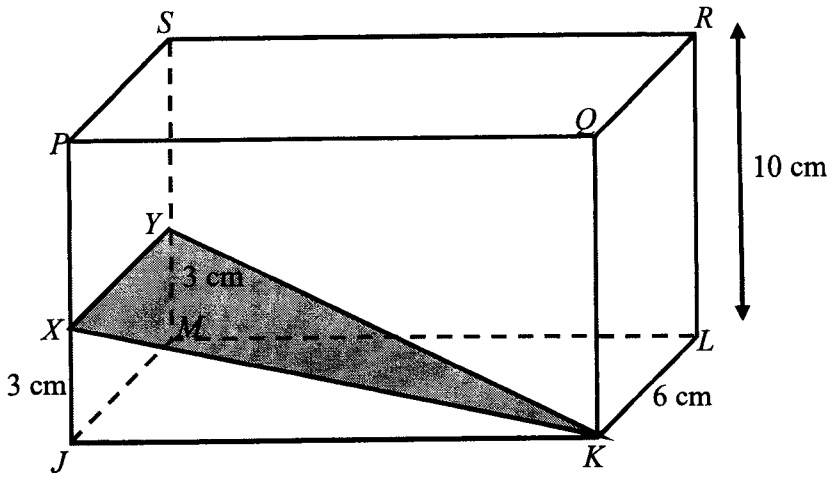
.....[2]

(iii) Find $\dfrac{\text{area of triangle } OPY}{\text{area of triangle } OQY}$.

Answer ..... [1]

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9 **(a)** The figure shows a sloping triangle XYK in a cuboid. The cuboid has a base width of 6 cm and height 10 cm. $XJ = YM = 3$ cm.



(i) Given that $YK = \sqrt{369}$ cm, explain why $XK = \sqrt{333}$ cm.

Answer

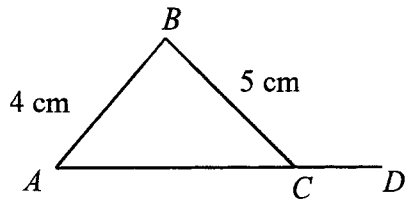
[2]

(ii) Suppose $JK = 18$ cm, find $\angle XPK$, to the nearest degree.

Answer ..... ° [3]

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(b) In the diagram, ACD is a straight line. $AB = 4$ cm, $BC = 5$ cm and $\sin \angle BCD = \frac{3}{4}$.



(i) Find angle ABC.

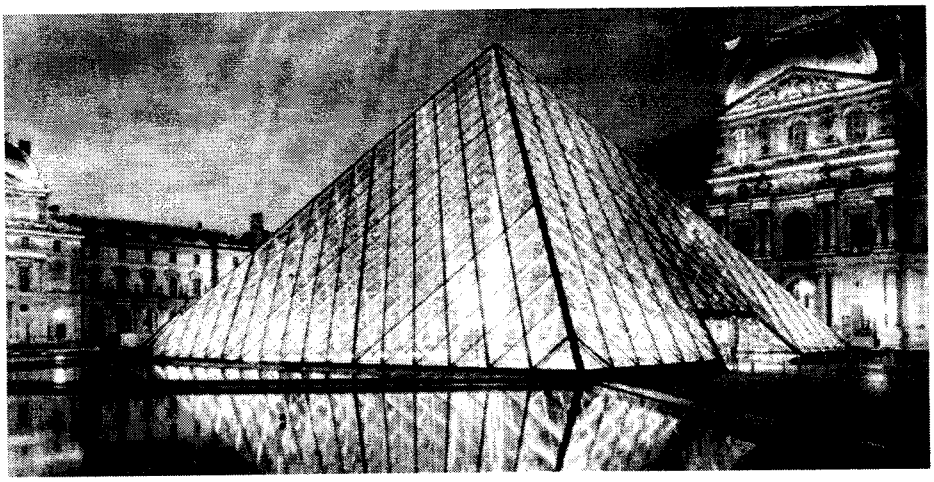
Answer .....° [3]

(ii) Hence find the area of triangle ABC.

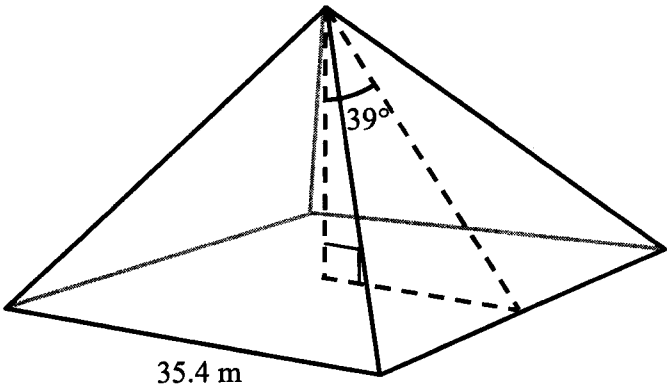
Answer .....cm^2 [1]

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10



The photograph above shows the picture of the Louvre Pyramid in Paris.
The angle formed by the slant height and vertical height of the pyramid is 39°. The Louvre Pyramid can be modelled by a square pyramid with base length 35.4 m as shown in the figure below.



(a) Show that the slant height of the pyramid is 28.126 m, correct to 3 decimal places.

Answer

[2]

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(b) Calculate the total surface area of the four lateral faces of the pyramid.

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

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(c) The Louvre Pyramid was constructed using glass panels and steel rods. Information on the construction materials used is as follows:

- 90% of the four lateral faces of the pyramid is covered with glass panels.
- The glass panels have uniform thickness of 21 mm.
- The density of the glass used for the panels is 2790 kg/m^3.

  [Density = $\frac{\text{Mass}}{\text{Volume}}$]
- The total mass of steel rods used is 95 tonnes. [1 tonne = 1000 kg]

A geometrically similar replica of the Louvre Pyramid is being constructed using the same materials and will be displayed on a raised platform for an exhibition.
The raised platform must be large enough to fit the base of the replica.
The base length of the replica pyramid is 4 metres.
The exhibition organisers need to select a suitable material for the raised platform.
The maximum load capacity and price of different materials for the raised platform are shown in the table below.

Platform material	Solid Hardwood	Marble	Concrete
Maximum load capacity	250 kg	500 kg	700 kg
Approx cost	\$8.50 per kg	\$300 per m^2	\$220 per 1.5 m by 1.5 m slab

* Concrete is sold in standard slab units, which are not designed to be cut or resized.

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Make a recommendation to the exhibition organisers on the choice of material for the raised platform. Justify your recommendation and show your calculations clearly.

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.....[7]

END OF PAPER

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