TANJONG KATONG GIRLS' SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR EXPRESS

CANDIDATE NAME

CLASS

INDEX NUMBER

MATHEMATICS

Paper 1

4052/01

21 August 2025

2 hours 15 minutes

Candidates answer on the Question Paper

READ THESE INSTRUCTIONS FIRST

Write your index number and name 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.
DO **NOT** WRITE ON ANY BARCODES.

Answer **all** the questions.
The number of marks is given in brackets [ ] at the end of each question or part question.

If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
The total of the marks for this paper is 90.

The use of an approved scientific calculator is expected, where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142.

For Examiner's use

This document consists of **24** printed pages and **2** blank pages.

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Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

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Answer **all** the questions.

1 **(a)** Simplify $\left(\frac{\sqrt[3]{a}}{3b^2}\right)^4$ and express your answer in positive index form.

Answer ..... [1]

(b) Solve $10\times3^6-2\times9^3=8\times3^k$.

Answer $k=$ ..... [2]

2 **(a)** Convert 2.4 radians into degrees.

Answer ..... [1]

(b) Area of triangle $XYZ=63$ cm^2, $XY=12$ cm, $YZ=15$ cm and $\angle XYZ$ is the largest angle in the triangle.
Find angle XYZ.

Answer ..... [2]

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3 Mr Tan had lunch with his friends at a restaurant to celebrate his birthday.
They ordered a meal from a set menu at a special price of $\$x$.
In addition, they ordered some dishes from the a la carte menu at \$96. All dishes from the a la carte menu would be entitled to 20% birthday discount.
After adding 10% service charge and 9% goods and service tax (GST), they paid \$257.55
Find x, correct to the nearest whole number.

Answer x = ... [2]

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4 **(a)** $\sqrt[6]{x} = a \times b^2 \times c^3$ where a, b and c are different prime numbers.

Amy claimed that x is a perfect square and a perfect cube. Do you agree? Explain your answer.

Answer

.....

.....

..... [2]

(b) The numbers $y = 2^7 \times 5^{11} \times 13^{21}$ and $z = 2^7 \times 5^{10}$.

(i) The integer $w = y \div m$ is a perfect cube.

Find the smallest possible value of m. Write your answer as a product of its prime factor.

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

(ii) The lowest common multiple and highest common factor of v, y and z are $2^8 \times 5^{11} \times 13^{21}$ and $2^7 \times 5^9$ respectively.

Find the smallest possible value of v as a product of its prime factors.

Answer $v =$ ..... [1]

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5 Raymond invests \$8000 at a rate of 0.5% per quarter compound interest.

(a) Explain why the first year's interest is not 2% of \$8000.

Answer

.....

.....

..... [1]

(b) Calculate the interests of his investment at the end of 2 years.

Answer ..... [2]

6 The expression $x^2 - 20x - a$ is equivalent to $(x+b)^2 - 125$.

Find the value of a and b.

Answer $a =$ .....

$b =$ ..... [2]

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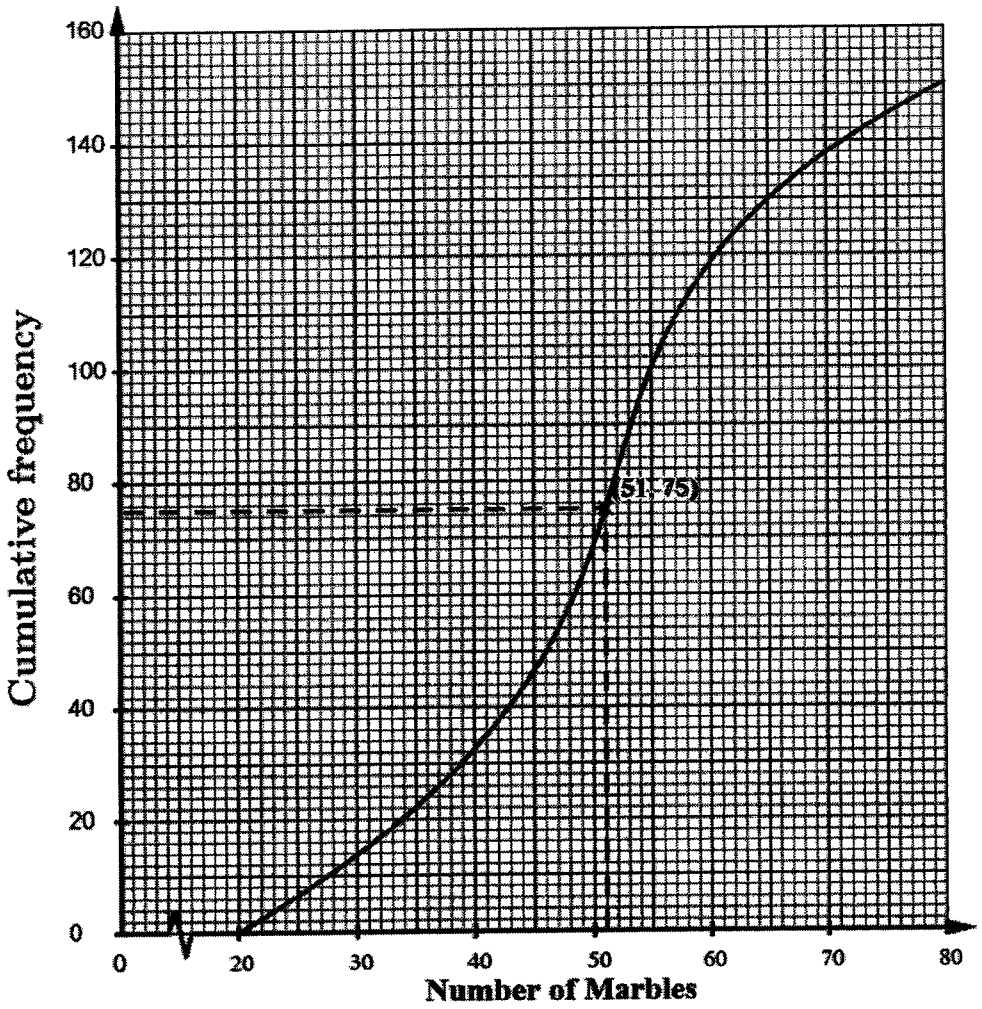
7 A tank was filled with some pebbles and x cm^3 of water.
Initially, the total volume of pebbles and water was 50% more than the empty space left in the tank while the volume of pebbles was 10% of the volume of water.
After 3600 cm^3 of pebbles were added, the volume of pebbles became 25% of the volume of water.
Find the value of x and, hence, find the capacity of the tank.

Answer x =.....

Capacity of tank = ...cm^3 [3]

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8 A group of 150 teenagers were asked to estimate the number of marbles in a jar. The cumulative frequency diagram represents their estimates.



(a) Use the diagram to find the

(i) number of teenagers whose estimate for the number of marbles, n, is $40 \leq n < 60$.

Answer ..... [1]

(ii) number of teenagers who estimated at least 60 marbles.

Answer ..... [1]

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(iii) 20^{th} percentile.

Answer ..... [1]

(b) Explain the meaning of the point (51, 75) in this cumulative frequency diagram.

Answer

.....

.....

..... [1]

(c) The actual number of marbles in the jar is 47. This is the *pth* percentile.

(i) Write down the value of p.

Answer p =..... [1]

(ii) Find the probability that two teenagers chosen at random underestimated the number of marbles.

Answer ..... [1]

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9 Below are some exchange rates offered by two money changers in Singapore.

ABC Money Changer		
Currency	Sell	Buy
United States Dollar (USD)	1.29	1.26
Chinese Yuan (CNY)	0.18	0.176

XYZ Money Changer		
Currency	Sell	Buy
United States Dollar (USD)	1.285	1.27
Chinese Yuan (CNY)	0.182	0.175

(a) Jane wants to change 200 USD to Singapore dollars (SGD).

(i) Which money changer should she go to?

Answer

Jane should go to ..... Money Changer because for every USD, she can get ..... more SGD than changing her money at ..... Money Changer. [1]

(ii) How much SGD will she receive?

Answer SGD..... [1]

(b) Jane wants to change 550 Singapore dollars (SGD) to Chinese Yuan (CNY).

(i) Which money changer should she go to?

Answer

Jane should go to ..... Money Changer because for every 1 CNY, she will pay ..... less SGD than changing her money at ..... Money Changer. [1]

(ii) How much CNY will she receive?

Answer CNY..... [1]

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

Answer ..... [2]

(b) Simplify $\frac{4x-6}{16x^4-81}$.

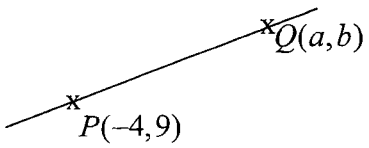
Answer ..... [2]

(c) Factorise completely $15ac - 6bc + 30ad - 12bd$.

Answer ..... [2]

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11 P is the point $(-4,9)$ and Q is the point (a,b).
Line PQ is parallel to the line $2y-3x=10$.



Find a in terms of b.

Answer $a =$ ..... [2]

12 The mass of 20 potatoes and 25 carrots were shown below.

Potatoes	Stem	Carrots
	7	8 9
3	8	2 4 7 9 9
6 5 2 2 1	9	1 4 5 6 7 8 9 9 9
8 5 4 3 1 1 0 0	10	1 3 8
9 8 4 2 1 0	11	x 2 3 8 8 8

Key (Potatoes)
3 | 8 represents 83 grams

Key (Carrots)
9 | 1 represents 91 grams.

(a) Write down the median mass of the potatoes.

Answer ..... grams [1]

(b) The interquartile range of the masses for the carrots is 20 grams. Find x.

Answer ..... [2]

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13 Explain why $(3x-2)^2-6(1-x)(x+1)-1$ is a non-negative multiple of 3 for all natural numbers x.

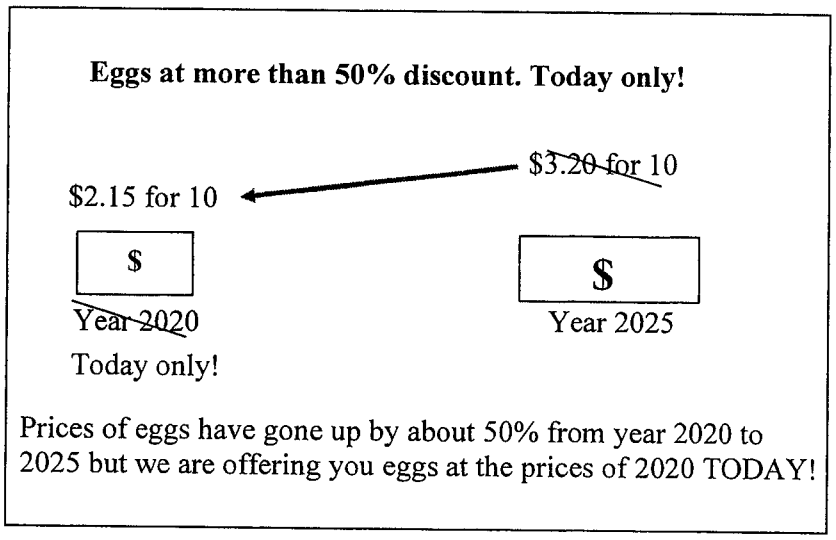
Answer

.....

.....

..... [2]

14 A company that sells eggs displays this promotion poster.



Explain one aspect of the poster that is misleading.

Answer

.....

.....

.....

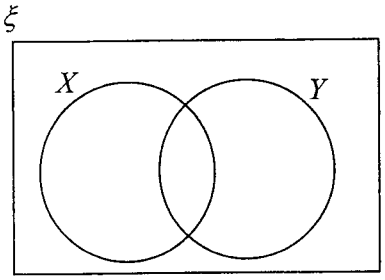
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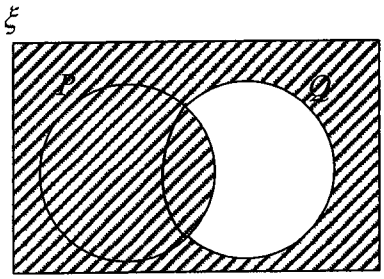
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15 **(a)** On the Venn Diagram, shade the region which represents $(X \cap Y') \cup (X' \cap Y)$.

Answer [1]



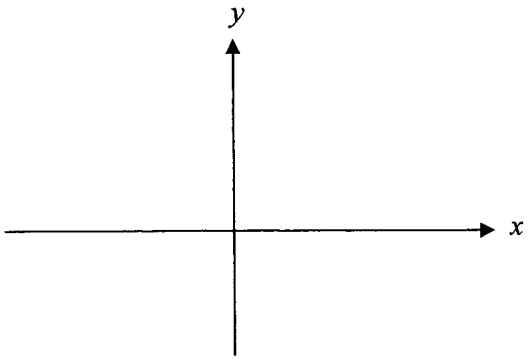
(b) Use set notation to describe the shaded region.



Answer ..... [1]

16 Sketch the graph $y = -(x+4)(x-6)$ on the axes below. Indicate clearly the equation of the line of symmetry, the coordinates of the turning point and the points where the graph crosses the axes.

[3]



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17 Diagram *A* shows a sealed right-pyramid with a square base containing some water.
Diagram *B* shows the cross section of the pyramid and water.

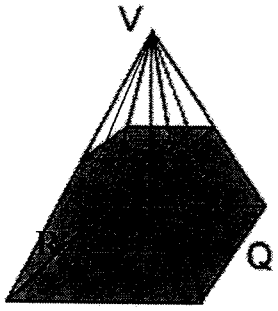


Diagram *A*

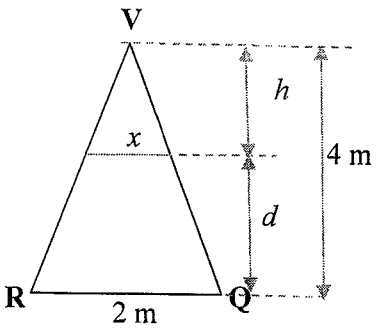


Diagram *B*

The square base is of length 2 m and the height of the pyramid is 4 m.
The length of the square surface area of the water is x m, the depth of the water is d m and the surface of the water is h m from the top of the pyramid.

(a) Show that $d = 4 - 2x$. [1]

(b) Given that the volume of the empty space is $\frac{1}{3}$ of the volume of the water, calculate d.

Answer d =..... [3]

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18 Mr Asahi is a Japanese tutor. He offers basic and advanced Japanese lessons. The matrix **S** shows the number of students he has each week.

$$\mathbf{S}=\begin{matrix}\text{Basic} & \text{Advanced} \\ \begin{pmatrix}6 & 5\\ 4 & 2\end{pmatrix} & \begin{matrix}\text{Weekdays}\\ \text{Weekends}\end{matrix}\end{matrix}$$

(a) Mr Asahi charges \$280 and \$320 per month for basic and advanced lessons respectively. Represent this information in a column matrix **C**.

Answer **C** =..... [1]

(b) Evaluate the matrix **P** = 12**SC** where **P** represents the annual fees collected for lessons on weekdays and weekends respectively.

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

(c) Mr Asahi wants to increase the monthly lesson fees for basic and advanced courses by 10% and 20% respectively.

Write down a matrix **N** such that **M** = **NC** where **M** is a 2 x 1 matrix that represents the new fees after the increase.

Answer **N** =..... [1]

(d) Evaluate the matrix **Q** = (1 1)**SM**.

Answer **Q** =..... [2]

(e) State what the element(s) of **Q** represent.

Answer

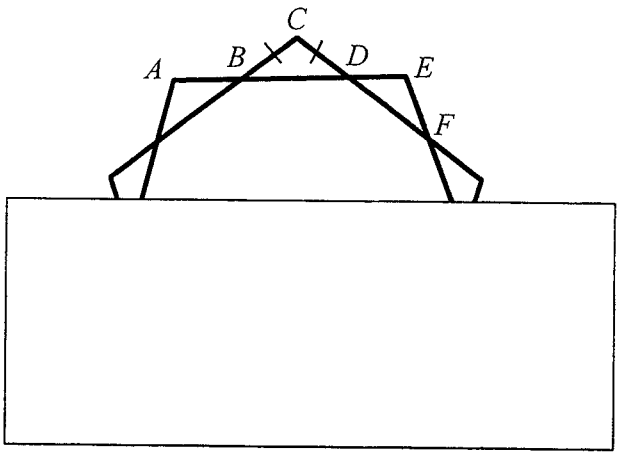
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..... [1]

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19 The partially covered star below is made up of an n-sided regular polygon in the centre surrounded by n isosceles congruent triangles.



(a) Given that $\angle BCD = 108°$ and $ABDE$ forms a straight line, find the value of n.

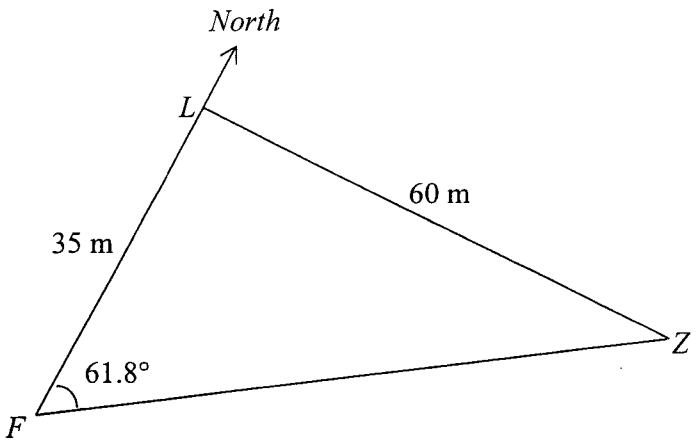
Answer $n =$ ..... [2]

(b) Find the interior angle of the regular n-sided polygon.

Answer ..... [1]

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20 The diagram shows the positions of a lioness L, a zebra foal F and a dazzle of zebras Z. $LF = 35$ m, $LZ = 60$ m and $\angle LFZ = 61.8°$.



(a) Find the bearing of F from Z.

Answer ..... [1]

(b) (i) Explain why is $\angle LZF$ an acute angle.

Answer

.....

.....

.....

.....

..... [1]

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20 **(b)** **(ii)** Find the bearing of Z from L.

Answer ..... [2]

(c) Find the length of FZ.

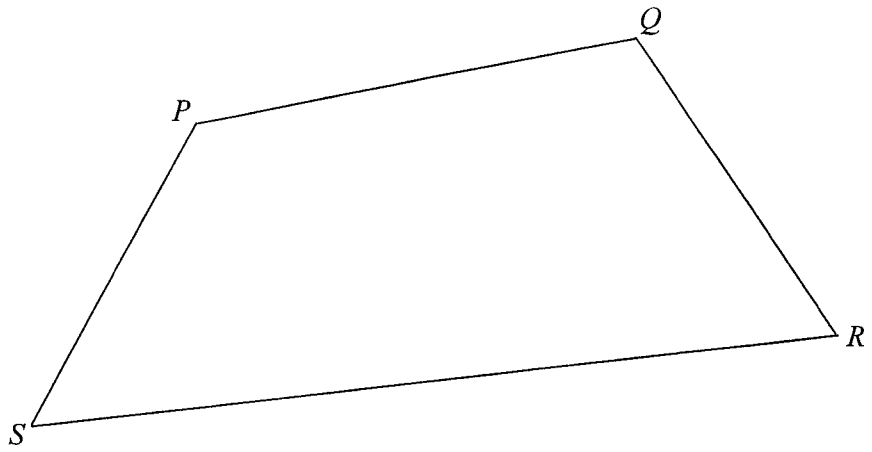
Answer ..... [2]

(d) The lioness at L spotted the foal at F.
If the foal ran from F to Z, find the shortest distance for the lioness to reach the foal from L.

Answer ..... [2]

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21 The diagram shows a garden $PQRS$.



(a) A new tower T is to be built at a location equidistant from PS and PQ.
Mark a possible location of the tower T on the diagram. [1]

(b) A new café C in the tower T is to be located equidistant from R and S.
Mark the final location of the café C on the diagram. [1]

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22 **(a)** Given the table of values, calculate and explain why x and y^2 are inversely proportional.

x	$\frac{1}{4}$	1	4	9
y	12	6	3	2

Answer

.....

.....

..... [1]

(b) Calculate the percentage reduction in x when y is increased by 150%.

Answer .....% [2]

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23 **(a)** The first four terms of a sequence are

$$8, \quad 5, \quad 2, \quad -1.$$

(i) Write down, in terms of n, the nth term of the sequence.

Answer ..... [1]

(ii) The first four terms of another sequence are

$$9, \quad 9 \quad , \quad 11 \quad , \quad 15.$$

By comparing this sequence with the sequence in part (a), write down, in terms of n, the n^{th} term of this sequence.

Answer ..... [1]

(b) Sum of the first n terms of a new sequence with a common difference is

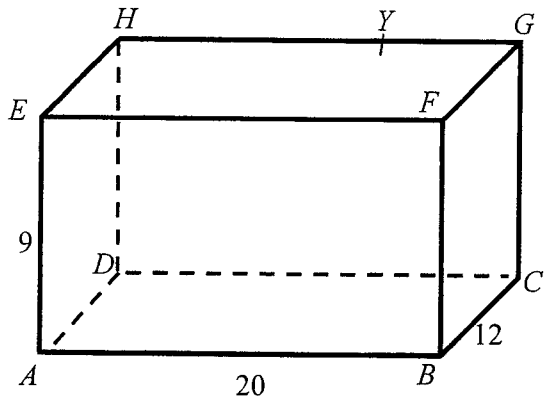
$S_n = \frac{n}{2}(7n-3)$.

Find the nth term of this new sequence.

Answer ..... [2]

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24 The diagram shows a cuboid container $ABCDEFGH$.
$AB = 20$ m, $BC = 12$ m, $AE = 9$ m, Y is a point on GH such that $HY : YG = 3 : 2$ and $AY = \sqrt{369}$ m.



(a) Find $\angle AYB$.

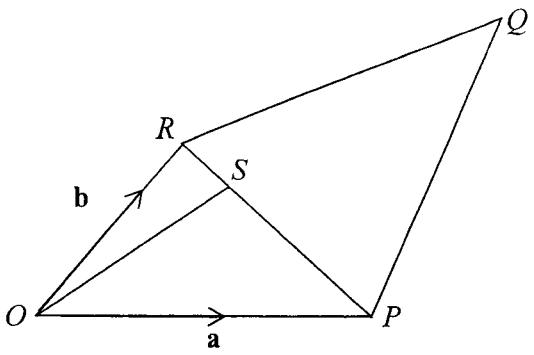
Answer ..... [3]

(b) Find the largest angle of depression of AB from Y.

Answer ..... [2]

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25 $OPQR$ is a quadrilateral. $\overrightarrow{OP} = \mathbf{a}$, $\overrightarrow{OR} = \mathbf{b}$ and $RS = \frac{1}{4}RP$.



(a) Given that $\overrightarrow{RQ} = \frac{2}{3}\mathbf{a} + \mathbf{b}$, show that O, S and Q form a straight line.

Answer

.....

..... [2]

(b) X is a point on OP such that XS is parallel to QP.
Find $\overrightarrow{XS}$ in terms of **a** and **b**.

Answer $\overrightarrow{XS}$ = ... [3]

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MATHEMATICS

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4052/02

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TURN OVER FOR QUESTION 1

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1 **(a)** The table shows the total electricity consumption in Singapore over three years.

Year	2022	2023	2024
Total electricity consumption in Gigawatt hour (GWh)	50818	53715	55143

(i) Express the 2022 electricity consumption in Gigawatt hours (GWh) in standard form correct to two significant figures.
[1 GWh = 10^9 Wh]

Answer .....GWh [1]

(ii) In 2023, the electricity consumed by households took up 16.5% of the total electricity consumption. Calculate the amount of electricity consumed by households in 2023, correct to two significant figures.

Answer .....GWh [2]

(iii) Calculate the percentage increase in the total electricity consumption from 2022 to 2024.

Answer .....% [2]

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(b) The speed of light is 3×10^8 m/s. Find the distance, in kilometres, travelled by light in 70 nanoseconds, giving your answer in standard form.
[1 nanosecond = 10^{-9}seconds]

Answer .....km [2]

(c) **(i)** The actual length of a transistor is 0.25 mm.
In a scale drawing, the length of the same transistor is x mm.
Given that the scale used is 20 :1, find the value of x.

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

(ii) Made to the same scale as the transistor, the actual surface area of a microprocessor is 120 mm^2, find the surface area of the microprocessor in in a scale drawing in square centimetres.

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

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2 **(a)** Solve $2(5-4x)=3x-1$.

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

(b) Solve the inequalities $\frac{x+12}{3} \geq -3(x-3)$ and $5x-3<7$.

Answer ..... [3]

(c) Given the formula, $d=\frac{1}{2}\left(b^2c-7b^2\right)$

(i) Find the value of d when $b=-2$ and $c=5$,

Answer $d=$ ..... [1]

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(ii) Rearrange the given formula to make b the subject.

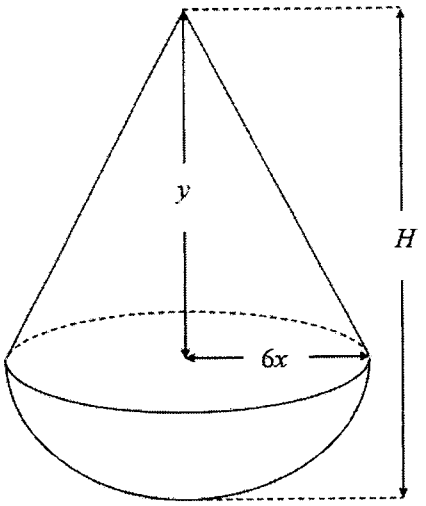
Answer $b =$ ..... [2]

(d) Solve the equation $\frac{x}{2x-1} - 3 = \frac{4}{x}$.
Give your solutions correct to two decimal places.

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

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3 The diagram shows a solid formed from a cone and a hemisphere.
The cone has base radius $6x$ cm and height y cm.
The hemisphere has radius $6x$ cm.



(a) The volume of the cone is twice the volume of the hemisphere.
Find y in terms of x.

Answer $y =$ ..... [4]

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(b) The total surface area of the solid is 600 cm^2. Find the value of H.

Answer $H =$ ..... [5]

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4 **(a)** Complete the table of values for $y = \frac{1}{x^2} + 3x$.

Values are given to one decimal place where appropriate.

x	−3	−2	−1	−0.5	0.3	0.5	1	2	3
y	−8.9	−5.8	−2	2.5	12.0	5.5	4	6.3	

[1]

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

(c) **(i)** On the same grid, draw the graph of $y - 2x = 5$ for $-3 \leq x \leq 3$. [2]

(ii) Write down the x-coordinates of the points where the line intersects the curve.

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

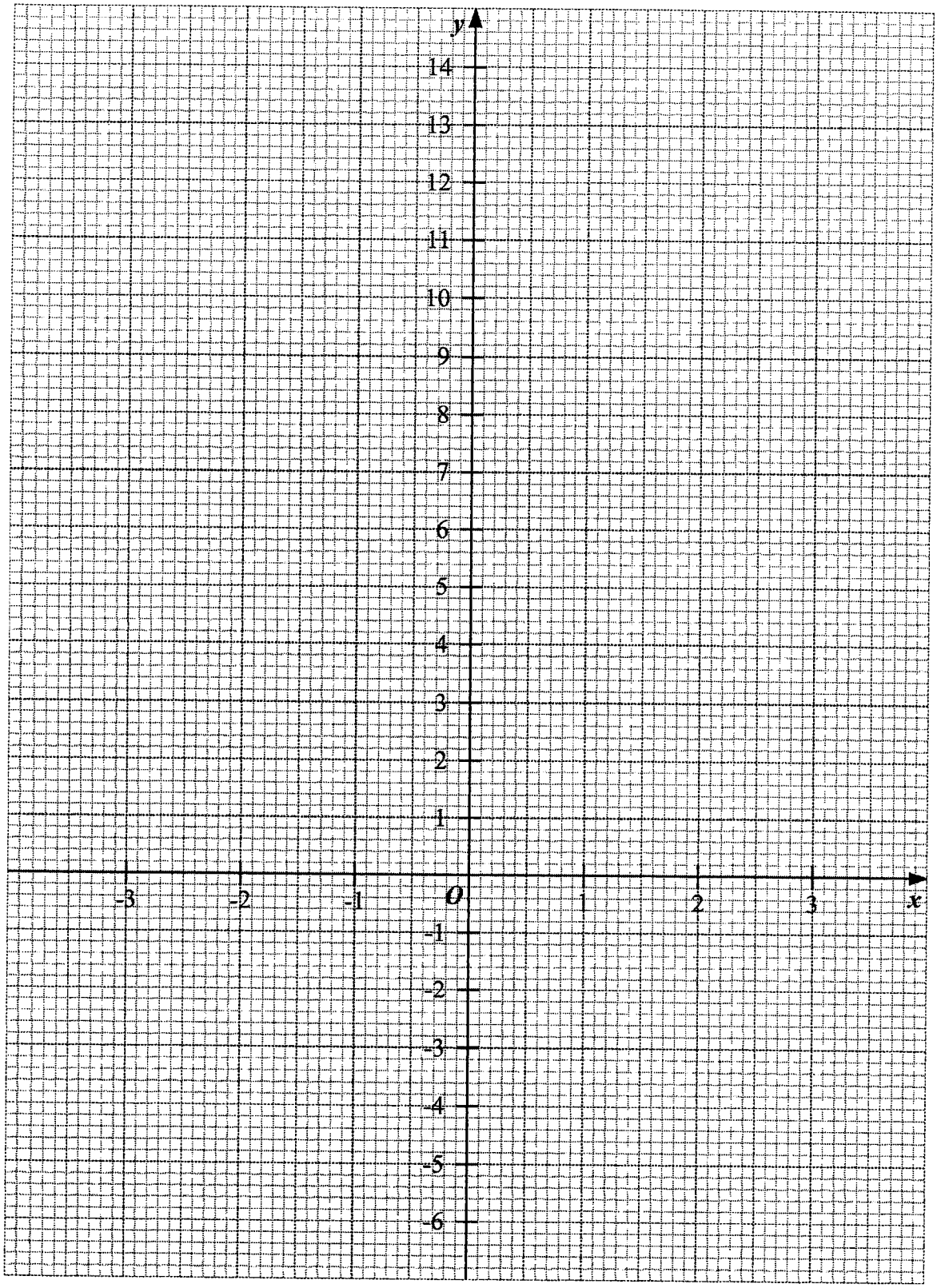
(iii) These values of x are the solutions of the equations $Ax^3 + Bx^2 + 1 = 0$.

Find the value of A and the value of B.

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

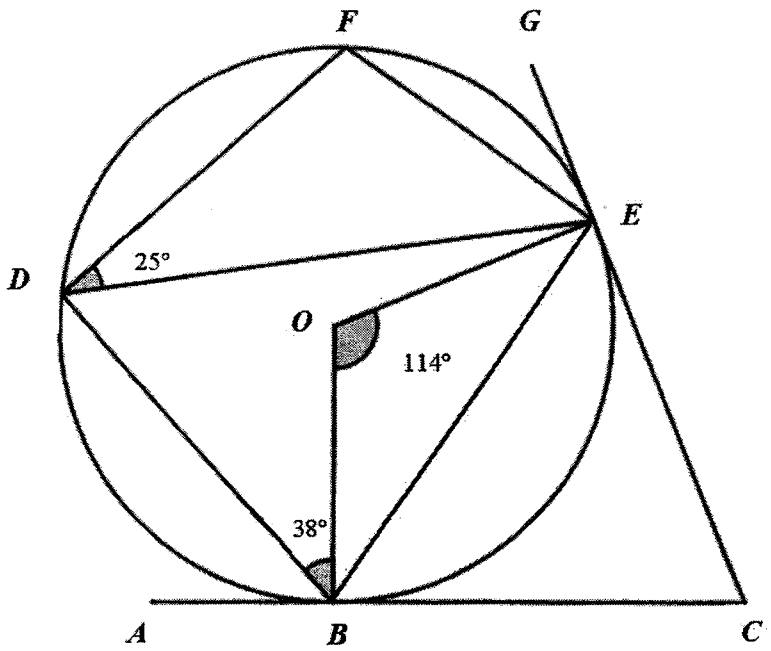
$B =$ .....

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5 In the diagram, B, D, E and F lie on the circle with centre O. AC and CG are tangents to circles at B and E respectively. It is given that angle $EDF = 25°$, angle $OBD = 38°$ and angle $BOE = 114°$

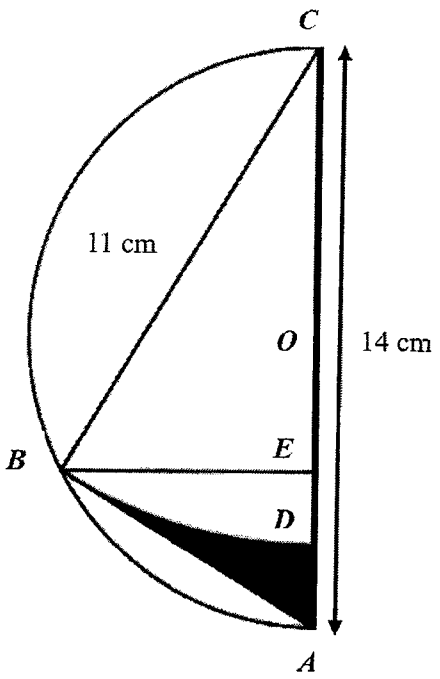


(a) Find angle FED.
Give a reason for each step of your working,

Answer angle FED = ...° [3]

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(b) The diagram shows a semicircle, centre O, with a diameter AC of 14 cm. CD is perpendicular to AB. BD is an arc of a circle with C as the centre and radius 11 cm.



(i) Show that angle $BCE = 0.667$ radian when corrected to 3 significant figures. [1]

(ii) Calculate the area of the shaded region.

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

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6 **(a)** A is the point $(1, -4)$ and B is the point $(-7, -2)$. The point C is the result of the translation of point B by $\begin{pmatrix} 5 \\ 4 \end{pmatrix}$.

(i) Find the coordinates of point C.

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

(ii) Find the equation of the line AC.

Answer ..... [3]

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(b) J is a point $(-2, m)$ and K is a point $(10, 1)$

The equation of the line JK is $y = -\frac{1}{2}x + 6$.

(i) Find the value of m.

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

(ii) Hence, find the length of the line JK.

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

(iii) The line with equation $6y + px = 16$ intersects the line JK at the point $(q, 5)$, where p and q are constants.
Find the value of p and the value of q.

Answer $p =$ .....

$q =$ ..... [4]

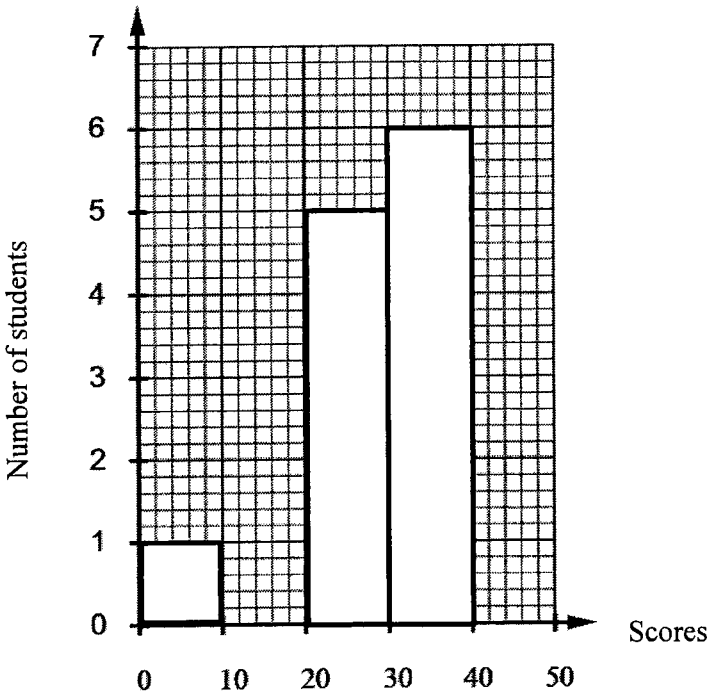
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7 **(a)** The stem-and-leaf diagram shows the scores of a group of students in an English test.

0	6						
1	8	9					
2	1	6	8	8			
3	0	2	3	6	6	6	7
4	4	4	5	7			
5	0	0					

Key: 1 | 8 represents 18 marks

(i) The values in the stem-and-leaf diagram are used to construct the histogram below. Complete the histogram. [1]



Using the histogram,

(ii) calculate the estimated mean of the scores.

Answer .....marks [1]

(iii) calculate the estimated standard deviation of the scores.

Answer .....marks [1]

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(b) The mean and standard deviation values of the stem-and-leaf diagram are in the table below.

Mean	33.3 marks
Standard deviation	11.4 marks

Give a reason for the difference in values between the table above and the values found in **a(ii)** and **a(iii)**.

.....

.....

.....

..... [1]

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(c) There are 30 coloured balls in a bag. 5 balls are red, 9 are blue and the rest are green.

(i) A ball is selected from the bag at random.
Find the probability that the selected ball is green.

Answer ..... [1]

(ii) Two balls are selected from the bag at random without replacement.
Find the probability that both the selected balls are of the same colour.

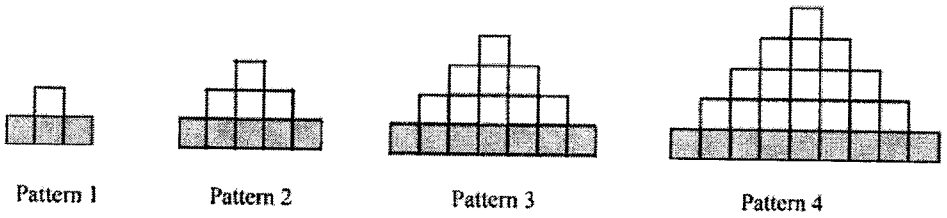
Answer ..... [2]

(iii) Two balls are selected from the bag at random with replacement.
Find the probability that both the selected balls are of different colour.

Answer ..... [2]

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8 **(a)** The diagram shows a sequence made by using grey and white squares.



(i) Complete the table below. [2]

Pattern Number	n
Number of grey squares	
Number of white squares	

(ii) Determine if any sequence can be formed with 1381 white squares. [2]
Justify your answers with clear working.

(iii) Show that $n^2-(2n+1)=(n-1)^2-2$ [1]

(iv) Hence or otherwise, show that the number of white squares will be greater than the number of grey squares when $n \geq 3$. [2]
Justify your answers with clear working.

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(b) Jonathan buys a car on hire purchase.
He made a 25% downpayment and takes up a 7-year loan which charges simple interest at 3.78% per annum.
Given that he pays $1850 monthly instalment for the car, calculate the cash price of the car.
Give your answer correct to the nearest dollar.

Answer $..... [4]

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9 Mr Goh would like to replace all 60 units of air conditioners in his office building. He is considering between two brands of air conditioners.

Information about the two brands of air conditioners is shown in the table below.

Brand	A	B
Price of each air conditioner unit (after GST)	S$1288	S$840
Power consumption per air conditioner unit per hour	3 kW	3.2 kW
Frequency of repair, maintenance and servicing of air conditioner units	Twice a year	Four times a year
Total cost for repair, maintenance and servicing of 60 units	S$2100 per visit	S$1000 per visit
Warranty* (activated upon purchase)	Three years	Two years
*Warranty covers free of charge repair, maintenance and servicing of air conditioner units with free replacement of parts for the stated duration. (non-extendable)		

The latest Electricity Tariff* is shown in the table below.

*An electricity Tariff is the pricing structure used to determine how much you pay for electricity consumption

	Tariff (without GST)	Tariff (with GST)
kWh* charge (¢ per kWh)	28.12	30.65
* kWh (kilowatt-hour) is a unit of energy equal to one kilowatt (kW) of power sustained for one hour		

The usage of air conditioner units in Mr Chen's office building is shown in the table below.

Days	Usage time per unit	Number of units used
Monday	8 hours	45
Tuesday to Friday	7 hours each day	60
Saturday and Sunday	No usage	

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(a) Work out the amount of energy used, in kWh, when a Brand **A** air conditioner is operates for 6 hours.

Answer ..... kWh [1]

(b) Mr Goh's office building operates for 50 weeks per year. (excluding public holidays).
Find the total hours of usage of the air conditioner units in the office building for a year.

Answer .....h [2]

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(c) Based on the usage of his office building, which air conditioner model will have a lower cost after first 4 years of use?
Justify your decision with clear working and state one assumption that you took into consideration.

Answer

.....

..... [7]

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