

A1

121 is a perfect square.

It has the property that the sum of its digits
($1 + 2 + 1 = 4$) is also a perfect square.

Find the number of perfect squares n ,
where $0 < n < 400$, such that the digit sum of n is
also a perfect square.



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A2 *T is the number that you will receive.*

The Fibonacci sequence is defined by $F_1 = F_2 = 1$, and $F_{n+1} = F_n + F_{n-1}$ for all $n \geq 2$. Let x be the number of values of n , $1 \leq n \leq T$, for which F_n is a triangular number.

Pass on the value of x .



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A3 *T is the number that you will receive.*

Let T be the lowest common multiple of two distinct integers a and b .

Pass on the largest possible value of the highest common factor of a and b .



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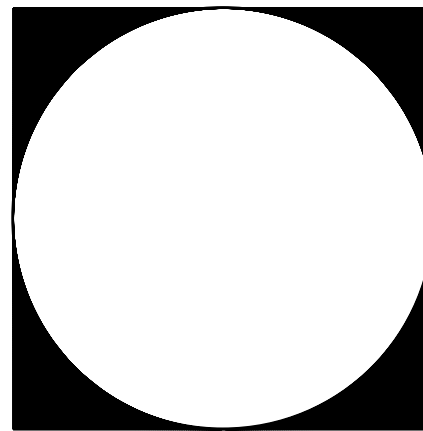
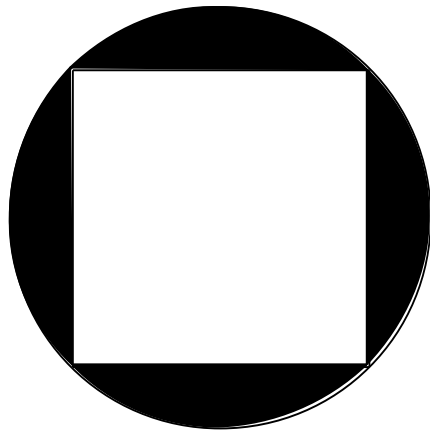


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A4 *T is the number that you will receive.*

Let the radius of both circles below be T .



Calculate the total shaded area.



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B1

The last non-zero digit of $5!$ is 2.

$$(5! = 1 \times 2 \times 3 \times 4 \times 5 = \underline{120})$$

Pass on the last non-zero digit of $10!$



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B2 *T is the number that you will receive.*

The distance between the points of intersection of the curve $y = x^2 - 6x + 12$ and the line $y = x + \frac{T}{4}$ can be expressed as $n\sqrt{2}$.

Pass on the value of n .



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B3 *T is the number that you will receive.*

Solve the equation

$$9^{7T+x} = \left(\frac{1}{3}\right)^{2x+2-20T}$$

Pass on the value of x .



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B4 *T is the number that you will receive.*

The geometric mean of two quantities P and Q is defined to be \sqrt{PQ} .

Let the geometric mean of $7T$ and $T + 3$ be x .

Find the value of x .



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C1

A train leaves Leeds for Edinburgh at 1:00pm, another train leaves Edinburgh for Leeds at 1:50pm. Both trains travel at the same uniform speed and take 3 hours to complete the journey. At what time do the trains pass each other?

Your answer should be in the form $a:bc$ pm.
Pass on the value of $a + b - c$.



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C2 *T is the number that you will receive.*

Write $\frac{T+1}{\sqrt{x}} \times \frac{T}{\sqrt[3]{x}}$ in the form ax^{-b} .

Pass on the value of ab .



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C3 *T is the number that you will receive.*

Express $\frac{3 + \sqrt{T}}{\sqrt{T} - 2}$ in the form $a + b\sqrt{T}$.

Pass on the value of $a - b$.



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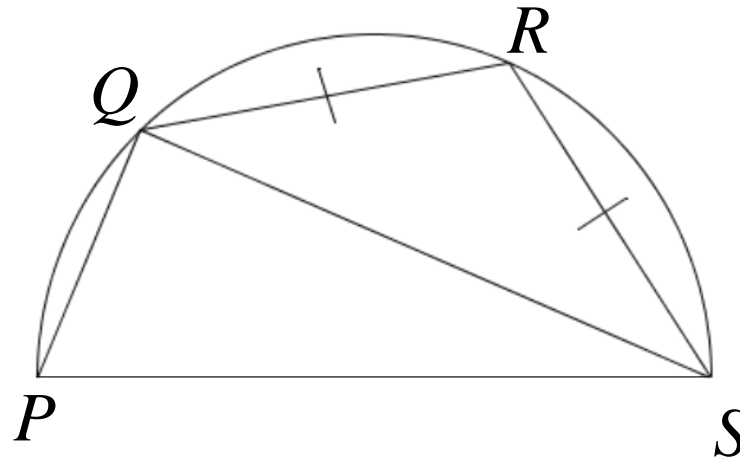


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C4 *T is the number that you will receive.*

In the diagram below PS is a diameter of the semicircle, $SR = RQ$, and $\angle PSQ = 7T$.



Find the value of $\angle RQS$.



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D1

Pass on the value of

$$2\sqrt{2} \times (\sqrt{32} - \sqrt{8})$$



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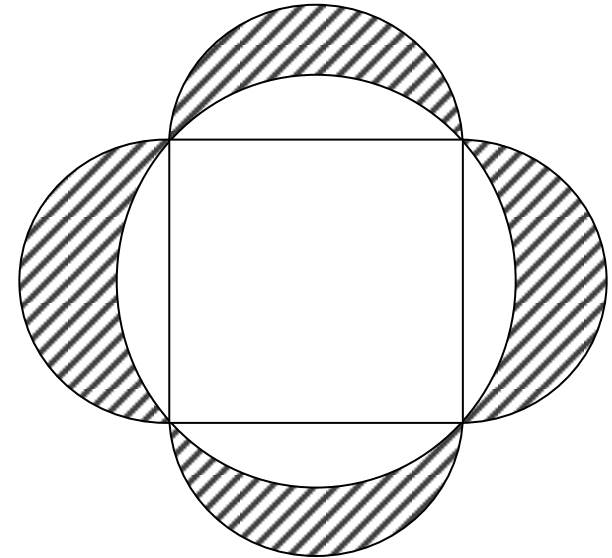


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D2 *T is the number that you will receive.*

A square of side T cm is inscribed in a circle.
Semicircles are constructed on its sides as shown.
Calculate the total shaded area.



Pass on the cube root of your answer.



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D3 *T is the number that you will receive.*

Simplify

$$\frac{4x^2 - 22x + 24}{x^2 - T^2} \times \frac{2x + 2T}{2x^2 - 5x + 3} \times \frac{3x^2 - x - 2}{4}$$

Your answer should be in the form $ax + b$.
Pass on $2ab$.



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D4 *T is the number that you will receive.*

The angles in an octagon can be arranged in an increasing sequence where the difference between each term and the next is T° .

Write down, in degrees, the difference between the largest and smallest angles.



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E1

The hot tap on its own fills a bath in 12 minutes. The cold tap on its own fills the bath in 10 minutes. When the plug is removed the full bath is emptied in $7\frac{1}{2}$ minutes. If both taps are turned on and the plug is removed, the bath will fill in M minutes.

Pass on the value of M .



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E2 *T is the number that you will receive.*

Solve the equation

$$y^2 - \left(\frac{1}{2}T - 2 \right)y + (T - 4) = 0$$

Pass on the value of $y^{\frac{1}{2}}$.



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E3 *T is the number that you will receive.*

A bag contains T red counters and N blue counters. Two counters are withdrawn, without replacement. It is known that the probability of both counters being blue is $\frac{2}{5}$.

Pass on the value of N .



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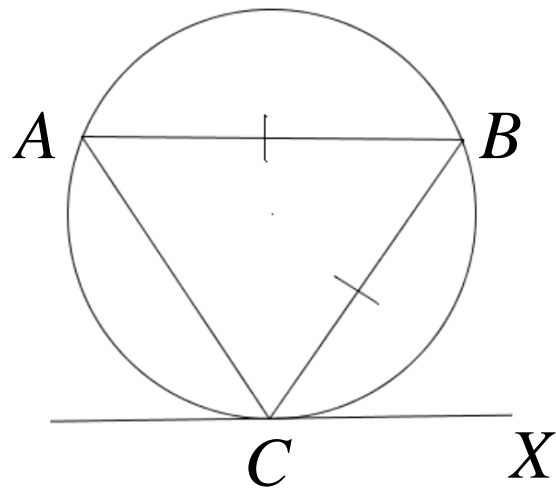


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E4 *T is the number that you will receive.*

CX is a tangent to a circle as shown below. An isosceles triangle *ABC* is drawn in the circle so that $AB = BC$ and $\angle BCX = (24T - 30)^\circ$.



Find the size of angle $\angle ABC$.



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F1

In the grid below, the middle expression of any row or column is calculated by taking the mean of the two vertically or horizontally adjacent expressions.

$2x$		$6x$
	$5x + 4$	
	$2x^2 + 2x + 2$	$10x + 2$

Pass on the *positive* value of x .



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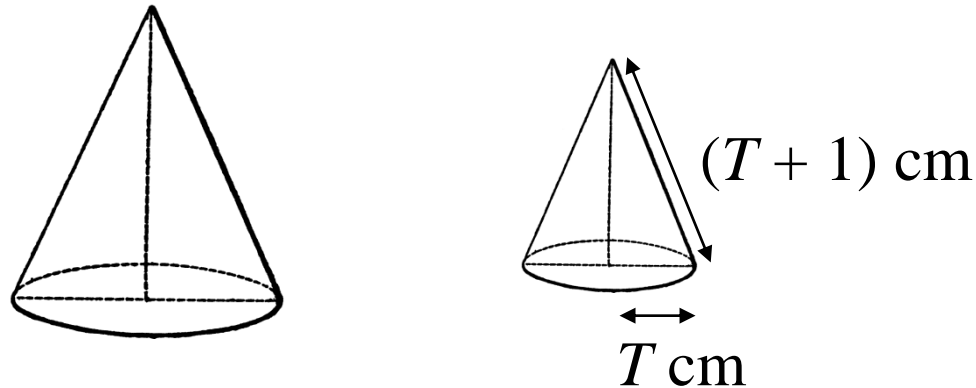


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F2 *T is the number that you will receive.*

The ratio of the volumes of two similar solid cones is 8:1. Calculate the difference in the surface areas.



Your answer should be in the form $a\pi \text{ cm}^2$.
Pass on one seventh of a .



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F3 *T is the number that you will receive.*

Given that

$$\frac{1}{x} + \frac{1}{y} = T + 3 \text{ and } x + y = T - 11,$$

write down the value of $12xy$.



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F4 T is the number that you will receive.

The function f is defined as

$$f(x) = \begin{cases} x - 12T & \text{if } x > 4 \\ x^2 + T^2 & \text{if } x = 4 \\ x - 6T & \text{if } x < 4 \end{cases}$$

Find the value of $f(5) - f(4) + f(3) - f(2)$.



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