

GROUP ROUND

INSTRUCTIONS

- Your team will have 40 minutes to answer 10 questions. Each team will have the same questions.
- Each question is worth 6 points. However, some questions are easier than others!
- You will have to decide your team's strategy for this group competition. Do you split up so that individuals work on a few questions each or do you work in pairs on a greater number of questions? Working all together on all the questions may well take too long. You decide!
- Remember that as in all Rounds of this competition answers should be given in simplified form, e.g. $\frac{3}{4}$ not $\frac{6}{8}$ and $2\sqrt{3}$ not $\sqrt{12}$.
- There is only one answer sheet per team. Five minutes before the end of the time you will be told to finalise your answers and write them on the answer sheet. This answer sheet is the only thing that will be marked.

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Question 1

Given that

$$y = \left(\sqrt{1 + \sqrt{x}} + \sqrt{1 - \sqrt{x}} \right) \left(\sqrt{1 + \sqrt{x}} - \sqrt{1 - \sqrt{x}} \right)$$

find the value of y when $x = 0.25$.



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Question 2

Calculate the area of the quadrilateral described in the (x, y) plane by the following inequalities.

$$x > 0$$

$$y > 0$$

$$x + y > 3$$

$$x + y < 4$$



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Question 3

The product

$$\sqrt{6} \times \sqrt{12} \times \sqrt{18} \times \sqrt{24} \times \sqrt{30} \times \sqrt{36} \times \sqrt{42}$$

can be expressed in the form $2^a 3^b 5^c 7^d$.

What is the value of $a + b + c + d$?



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Question 4

The natural numbers are arranged in a rectangular array as shown.

1	4	9	16	25	...
2	3	8	15	24	...
5	6	7	14	23	...
10	11	12	13	22	...
17	18	19	20	21	...
26	27	...			
...	...				

Assuming the pattern continues in this way, what number will be directly to the right of the number 2009?



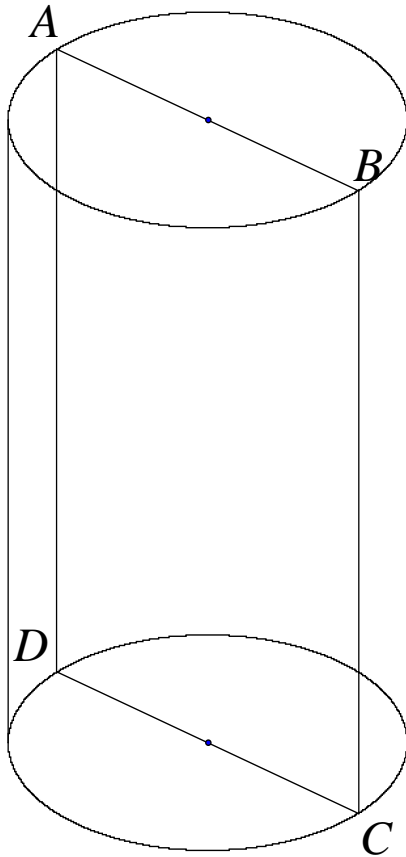
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Question 5

AB and DC are parallel diameters of the circular ends of a solid cylinder.

$ABCD$ is a rectangle with $AB = \frac{10}{\pi}$ cm and $BC = 12$ cm.



What is the shortest distance from A to C , measured along the curved surface of the cylinder?



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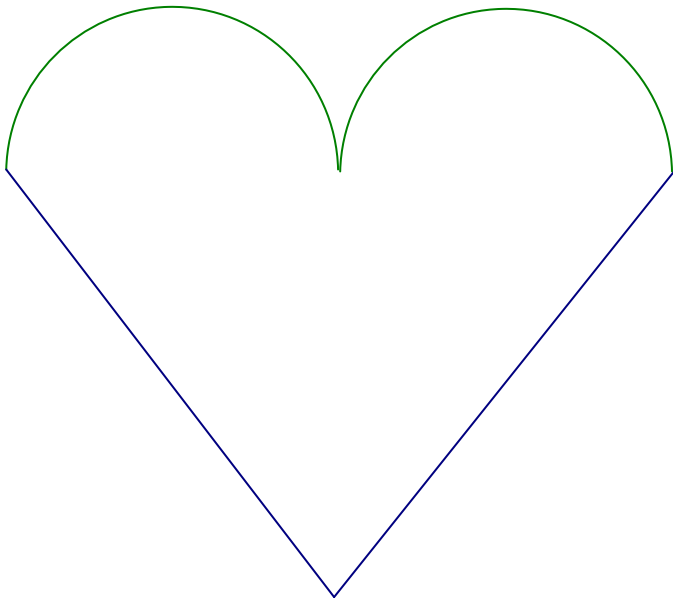
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Question 6

Valentino wants to create a heart shape from two equal semicircles and an equilateral triangle as shown. He also wants the value of the perimeter of the heart to be A cm and the value of the area of the heart to be A cm².



What is the exact value of the radius of the semicircles that makes this possible?



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Question 7

A function, T , is defined for positive integers a by

$$T(a + 1) = T(a) + a + 1 \quad \text{and}$$

$$T(1) = 1.$$

What is the smallest value of n such that $T(n) > 2009$?



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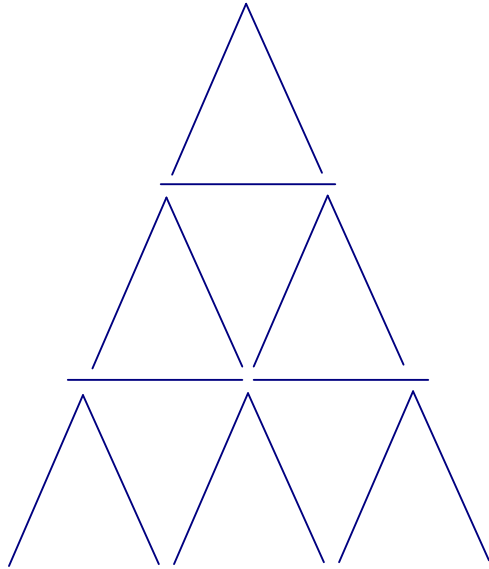
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Question 8

A house of cards with three storeys is built using 15 cards.



How many cards are needed to build a house 20 storeys high?



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Question 9

A French mathematician, Alphonse de Polignac (1817–1890) claimed that every odd number could be written as the sum of a power of 2 and a prime number.

He was in fact incorrect, despite checking as far as three million.

What is the smallest 3-digit counterexample to his claim?



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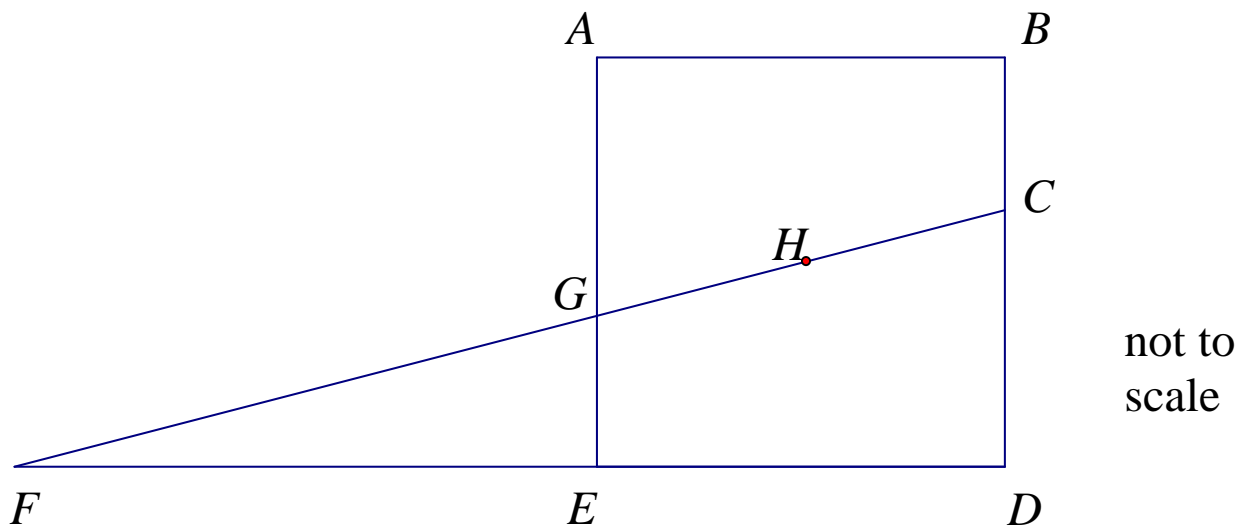
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Question 10

$ABDE$ is a square with centre H .

The base of the square DE is extended so that it meets the straight line CF which passes through H .



If $BC = 3$ cm and $CD = 4$ cm find the area of the triangle CDF .



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Group answer sheet

Team number

Team name

1. Value of y	2. Area of quadrilateral unit ²
3. $a + b + c + d =$	4. Number to the right of 2009
5. Distance from A to C cm	6. Value of the radius cm
7. Value of n	8. Number of cards
9. Three digit number	10. Area of triangle CDF cm ²

Award 6 points for each correct answer.

TOTAL SCORE = _____



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