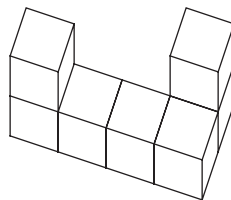
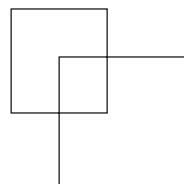


## From Stage 1

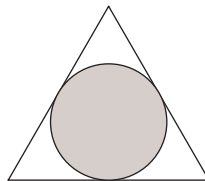
1. The solid below is made by glueing together seven 1 by 1 by 1 cubes. How many square units are in the surface area of the solid? Include the bottom surface.



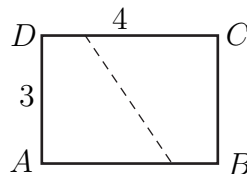
2. Square  $\mathcal{A}$  has area 9. Square  $\mathcal{B}$  has area 16, and one of its vertices is at the center of square  $\mathcal{A}$ . Moreover, the sides of  $\mathcal{B}$  are parallel to the sides of  $\mathcal{A}$ . Let  $a$  be the area of the region that is inside  $\mathcal{A}$  but outside  $\mathcal{B}$ , and let  $b$  be the area of the region that is inside  $\mathcal{B}$  but outside  $\mathcal{A}$ . What is  $b - a$ ?



3. Each side of the triangle has length 2 units. What is the number of square units in the area of the inscribed circle? Express your answer in terms of  $\pi$ .



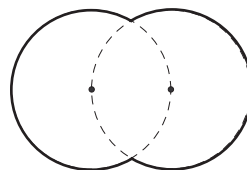
4. A 4 by 3 sheet of paper, represented by rectangle  $ABCD$ , is folded so that corner  $A$  lands on the diagonally opposite corner  $C$ , and then unfolded. What is the length of the fold line? (It is shown dashed in the picture.) Express the answer as a common fraction. The figure is not drawn to scale.



## From Stage 2

1. A test consisted of two parts, A and B. Zak got the right answer for 17 of the 30 questions in part A, but got the right answer for only one-third of the questions in part B. Overall, he got the right answer for one-half of the questions. How many questions were on the test?

- Alphonse and Beth ran for Student Council president. Beth got 60% of the vote, and Alphonse got the rest. Beth got 142 more votes than Alphonse. How many votes did Beth get?
- If  $81^{(3^2)} = 3^{(y^2)}$  and  $y$  is positive, what is  $y$ ?
- The greatest common factor of two numbers is 24. Their least common multiple is 480. One of the numbers is 96. What is the other number?
- The two circles that make up the figure have radius 6 cm. Each goes through the center of the other. A bug crawls around the outside of the figure once. How many cm does the bug crawl? Express your answer in terms of  $\pi$ .



- The figure below is made up of ten 1 cm by 1 cm squares. How many rectangles of perimeter 10 cm are there whose sides use only line segments in the figure?

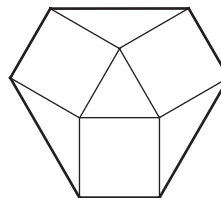


### From Stage 3

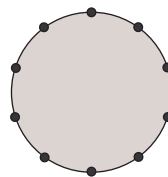
- How many triangles are there whose vertices are among the 10 points in the picture below? (The points lie on two horizontal lines and 5 vertical lines.)



- What is the largest integer  $n$  such that  $2^n$  divides  $3^{16} - 1$ ?
- In the figure below, the central triangle is equilateral with area 1. Squares are erected on the three sides of this triangle, and corners of the squares are joined as in the figure, to form a (non-regular) outer hexagon. What is the area of this hexagon? Express the answer in simplest radical form.

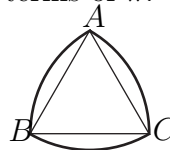


4. A group of 10 people, including Xavier, Yolande, and Zorba, get seated at random around a circular table. What is the probability that none of Xavier, Yolande, and Zorba are next to each other?



### From Stage 4

- Al bought a used car for \$1200. He sold it to Beth for five-sixths of what he paid for it. Beth sold it to Cecil for four-fifths of what she paid. Cecil sold it to Dee for three-quarters of what he paid. How many dollars did Dee pay for the car?
- How many perfect squares divide  $2^6 3^7$ ?
- The perimeter of equilateral triangle  $ABC$  is 15 cm. The three arcs are arcs of circles with centers  $A$ ,  $B$ , and  $C$ . How many cm are in the sum of the lengths of these arcs? Express the answer in terms of  $\pi$ .



- Express as a common fraction:  $4^{-2} - 5^{-2}$ .
- What is the 2005<sup>th</sup> term of the arithmetic sequence 1, 6, 11, 16, ...?
- The scale of a map reads 1 : 250 000. What is the distance, in kilometres, between two towns that are 7.6 centimetres apart on the map?
- Let  $P = 2 \cdot 3 \cdot 5 \cdot 7 \cdot 11$ . How many primes are there among the numbers  $P + 2$ ,  $P + 3$ ,  $P + 4$ ,  $P + 5$ , ...,  $P + 12$ ?
- Three distinct circles and one line are drawn in the plane. What is the largest possible number of points where two or more of these figures meet?
- Two classes took a provincial math exam. One class has 60 students; their average grade was 80%. The other class has 40 students; their average grade was 90%. What was the average grade of the 100 students?
- A movie started at 7:47 pm and ended at 9:37 pm. At what time was the movie exactly halfway through?
- Six consecutive odd integers add up to 120. What is the largest of these six integers?

12. Simplify:  $\frac{3}{0.0024}$
13. Let  $\mathcal{S}$  be the set  $\{1, 2, 4, 8, 16\}$ . How many distinct numbers are there of the form  $xy$ , where  $x$  and  $y$  are different members of  $\mathcal{S}$ ?
14. Beti has twice as much money as Alan. Cecil has \$20 more than Alan. And Deirdre has twice as much money as Cecil. Together they have \$300. How many dollars does Alan have?
15. What is the value of  $(2^{11})^{\frac{5}{11}}$ ?
16. Alphonse is shorter than Beth. Cecil is taller than Alphonse but shorter than Beth. Delbert is taller than Eve but shorter than Cecil and Alphonse. Of the five people listed, who is the shortest?
17. A circle passes through the points  $(0, 0)$ ,  $(10, 0)$ , and  $(0, 10)$ . Find the area of the circle. Express your answer in terms of  $\pi$ .
18. How many different five-digit numbers can be made using exactly two 1's, one 5, one 6, and one 7?
19. Two fair dice are tossed. What is the probability that the product of the numbers showing is a prime number? Express your answer as a fraction in lowest terms.
20. A bug travels in a straight line from the point  $(1, 2)$  to the point  $(10, 11)$ . What is the sum of the  $x$  and  $y$  coordinates of the position of the bug when it is two-thirds of the way to its destination?