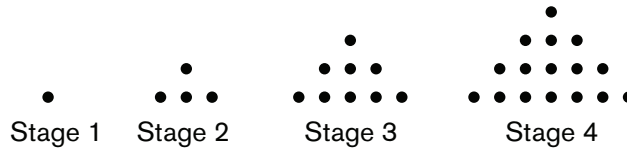




Patterns Stretch

11. _____ dots The first four stages of a dot pattern are shown. How many more dots are in the figure at Stage 47 than in the figure at Stage 27?



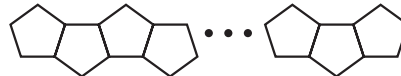
12. _____ The first three terms of a sequence are 1, 2 and 3. Each subsequent term is the sum of the three previous terms. What is the 11th term of this sequence?
13. _____ What is the sum of the terms in the arithmetic series $2 + 5 + 8 + 11 + 14 + \dots + 89 + 92$?
14. _____ Three consecutive terms in an arithmetic sequence are x , $2x + 11$ and $4x - 3$. What is the constant difference between consecutive terms in this sequence?
15. _____ What is the sum of the terms in the geometric series $1 + 4 + 16 + \dots + 1024$?
16. _____ What is the sum of the first 51 consecutive odd positive integers?
17. _____ What is the sum of the terms in the infinite series $1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \frac{1}{32} + \dots$?
18. _____ What is the sum of the terms in the infinite series $1 + \frac{1}{4} + \frac{1}{16} + \frac{1}{64} + \frac{1}{256} + \dots$? Express your answer as a common fraction.
19. _____ Let $f(x) = 2x + 3$ and $f^2(x) = f(f(x)) = f(2x + 3) = 2(2x + 3) + 3 = 4x + 9$. If $f^5(x) = ax + b$, what is the value of $a + b$?
20. _____ degrees The degree measures of the interior angles of a quadrilateral form a geometric sequence whose terms have integer values and are all integer multiples of the first term. What is the largest possible degree measure of an angle in this quadrilateral?

Patterns Stretch

The following problems are from previous School Handbooks and competitions. Enjoy!

1. _____ One digit of the decimal representation of $\frac{5}{7}$ will be chosen at random. What is the probability that the digit will be a 4? Express your answer as a common fraction. (1998 Chapter Countdown)

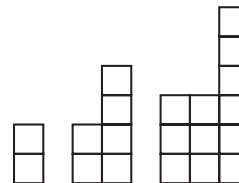
2. _____ inches A pentagon train is made by attaching regular pentagons with 1" sides so that each pentagon, except the two on the ends, is attached to exactly two other pentagons along sides, as shown. How many inches are in the perimeter of a pentagon train made from 85 pentagons? (1996 Chapter Target)



3. _____ What is the value of $x + y$ if the sequence 2, 6, 10, ..., x , y , 26 is an arithmetic sequence? ('04-'05 School Handbook)

4. _____ For what value of x is the equation $x + 2x + 3x + \dots + 99x + 100x = 100$ true? Express your answer as a common fraction. ('03-'04 School Handbook)

5. _____ blocks The first three towers in a sequence are shown. The n^{th} tower is formed by stacking n blocks on top of an n -by- n square of blocks. How many blocks are in the 99th tower? (1997 State Sprint)



6. _____ diagonals A diagonal of a polygon is a line containing two non-consecutive vertices. How many diagonals does a regular decagon have? ('02-'03 School Handbook)

7. _____ What is the value of the expression $\left(1 - \frac{1}{2}\right)\left(1 - \frac{1}{3}\right)\left(1 - \frac{1}{4}\right)\dots\left(1 - \frac{1}{n+1}\right)$ when $n = 12$? Express your answer as a common fraction. ('01-'02 School Handbook)

8. _____ The 25th day of the year 2003 fell on a Saturday. What day of the week did the 284th day of the year 2003 fall? (1995 State Countdown)

9. _____ If the pattern shown is continued, what is the sum of the terms in Row 12? ('00-'01 School Handbook)

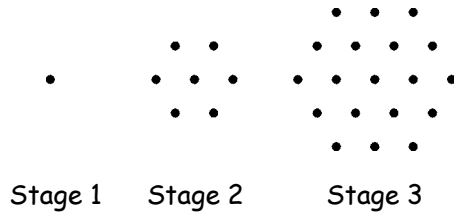
- Row 1 ... 2
- Row 2 ... 2 + 4
- Row 3 ... 2 + 4 + 6
- Row 4 ... 2 + 4 + 6 + 8
- Row 5 ... 2 + 4 + 6 + 8 + 10

10. _____ According to the linear function represented in this table, what is the value of x when $y = 8$? ('04-'05 School Handbook)

x	y
-4	23
1	20
6	17

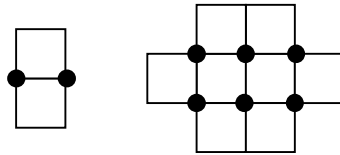
Patterns Stretch

- _____ What is the value of $\frac{2}{3} \times \frac{3}{4} \times \frac{4}{5} \times \dots \times \frac{8}{9}$? Express your answer as a common fraction.
- _____ What is the sum of $1 + 2 + 4 + 8 + 16 + \dots + 1024$?
- _____ If the pattern continues as shown below, how many dots will be in Stage 8?



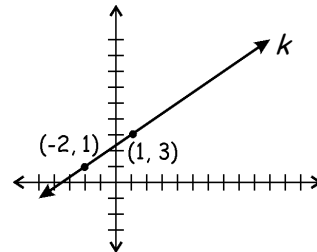
- _____ Note that $9^2 = 81$, which contains no zeros; $99^2 = 9801$, which contains 1 zero; and $999^2 = 998,001$, which contains 2 zeros. Assuming this pattern continues, how many zeros are in the expansion of $99,999,999^2$?
- _____ What is the units digit when 7^{53} is multiplied out?

(For #6 & #7) As shown, there are two unit squares that have at least two vertices among the points of the 1×2 array below, and there are eight unit squares that have at least two vertices among the points of a 2×3 array.



- _____ How many unit squares will have at least two vertices among the points of a 6×7 array?
- _____ How many unit squares have at least two vertices among the points of an $m \times n$ array? Express your answer in terms of m and n .

- _____ The point $(p, 9)$ lies on line k shown here. What is the value of p ?



- _____ Ron and Ameka are playing a game in which each player can take 1, 2 or 3 coins on each turn. The game begins with 17 coins in a pile, and the player to take the last coin from the pile wins. If Ameka goes first, how many coins should she take to guarantee that she will win?
- _____ If b is positive, what is the value of b in the geometric sequence $9, a, 4, b$? Express your answer as a common fraction.