

CODE BREAKER

PROBLEM SCORING:
2 POINTS

YOUR TASK IS TO DETERMINE THE VALUE OF EACH COLORED SHAPE.

$$\text{Blue Star} + \text{Purple Triangle} + \text{Green Heart} = 15$$

$$\text{Orange Cloud} + \text{Orange Cloud} + \text{Purple Triangle} + \text{Blue Star} = 18$$

$$\text{Blue Star} + \text{Purple Triangle} - \text{Green Heart} = 5$$

$$\text{Purple Triangle} + \text{Purple Triangle} + \text{Blue Star} = 13$$

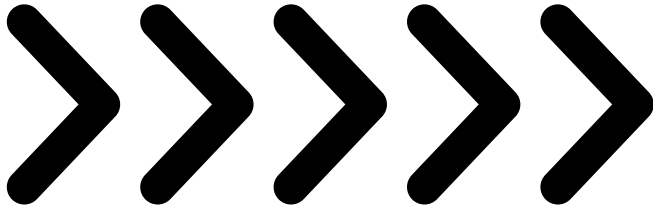
$$\text{Orange Cloud} + \text{Blue Star} + \text{Blue Star} - \text{Green Heart} = \text{Yellow Pentagon}$$

SOLUTION:



EVERYTHING YOU DO IS **RIGHT**

PART ONE
PROBLEM SCORING:
1 POINT



TODAY IS “EVERYTHING YOU DO IS RIGHT” DAY. LET’S PUT THIS THOUGHT TO TEST.

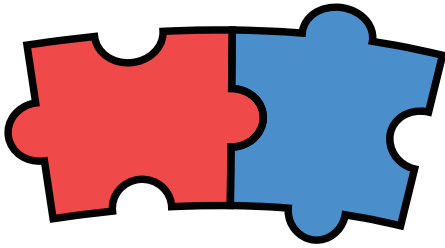
FOLLOW THE DIRECTIONS AND REPORT TO THE MASTER TEACHER WITH YOUR RESULT:

- CHOOSE A THREE-DIGIT NUMBER IN WHICH EACH DIGIT IS DIFFERENT.
- REVERSE THE ORDER OF THE DIGITS (THE HUNDREDS PLACE DIGIT IS NOW IN THE ONES PLACE, AND THE ONES PLACE DIGIT IS NOW THE HUNDREDS PLACE. THE TENS PLACE DIGIT STAYS PUT).
- SUBTRACT THE SMALLER THREE-DIGIT NUMBER FROM THE LARGER THREE-DIGIT NUMBER TO CREATE A NEW THREE-DIGIT NUMBER (DIFFERENCE).
- REVERSE THE ORDER OF THE DIGITS FOR THE DIFFERENCE (THE HUNDREDS PLACE DIGIT IS NOW IN THE ONES PLACE, AND THE ONES PLACE DIGIT IS NOW THE HUNDREDS PLACE. THE TENS PLACE DIGIT STAYS PUT).
- ADD THE DIFFERENCE AND REVERSE DIFFERENCE TOGETHER.
- WHAT IS YOUR SUM?

SOLUTION = 1,089

EVERYTHING YOU DO IS **RIGHT**

PART TWO
PROBLEM SCORING:
2 POINTS



THIS IS PART-TWO OF A TWO-PART PROBLEM:

- YOUR RESULT FROM PART-ONE SHOULD BE 1,089.
- YOUR NEW TASK IS TO VERIFY THAT ANY THREE-DIGIT NUMBER YOU CHOSE (WHEN EACH DIGIT IS DIFFERENT) WILL HAVE THE END RESULT OF 1089.

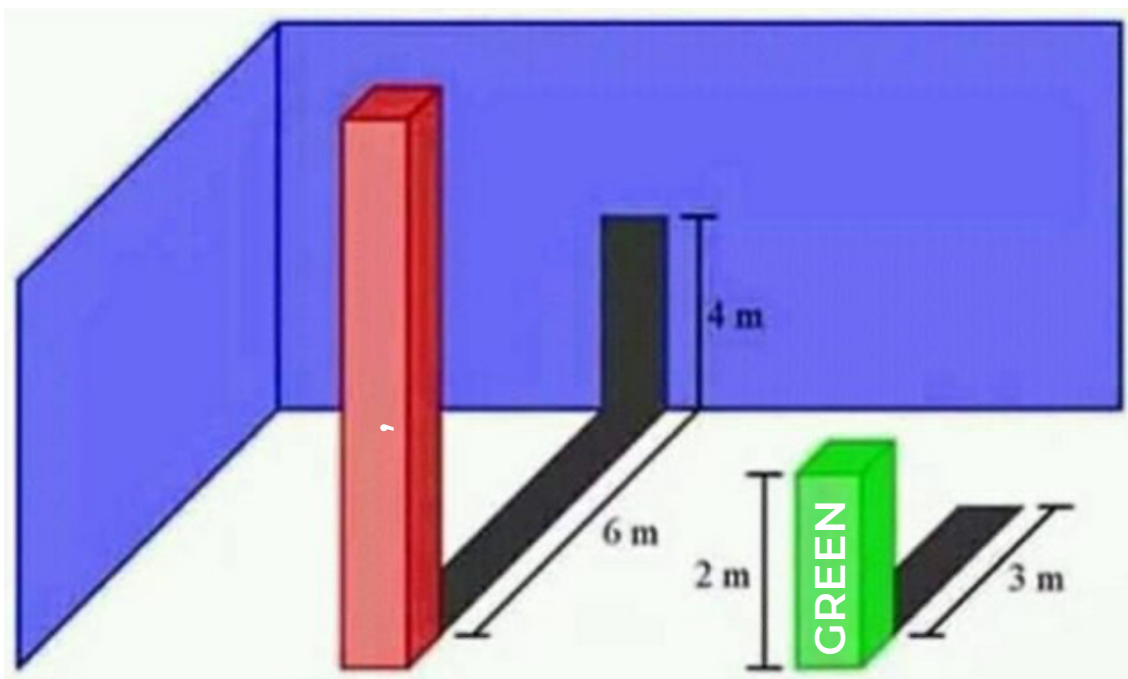
SOLUTION:

JUST LISTEN TO THE STUDENT REASONING (ANSWERS WILL VARY).

SHADOWS

PROBLEM SCORING:
3 POINTS

FIND THE HEIGHT OF THE RED BAR.*



(NOT DRAWN TO SCALE.)

*THE MASTER TEACHER CAN GIVE YOU A HINT TO THIS PROBLEM FOR A ONE-POINT DEDUCTION.

SOLUTION = 8m

SQUARE ROOTS

PART ONE
PROBLEM SCORING:
1 POINT

YOUR TASK:

DETERMINE THE $\sqrt{250}$ BETWEEN TWO INTEGER VALUES.



SOLUTION = 15 AND 16

SQUARE ROOTS

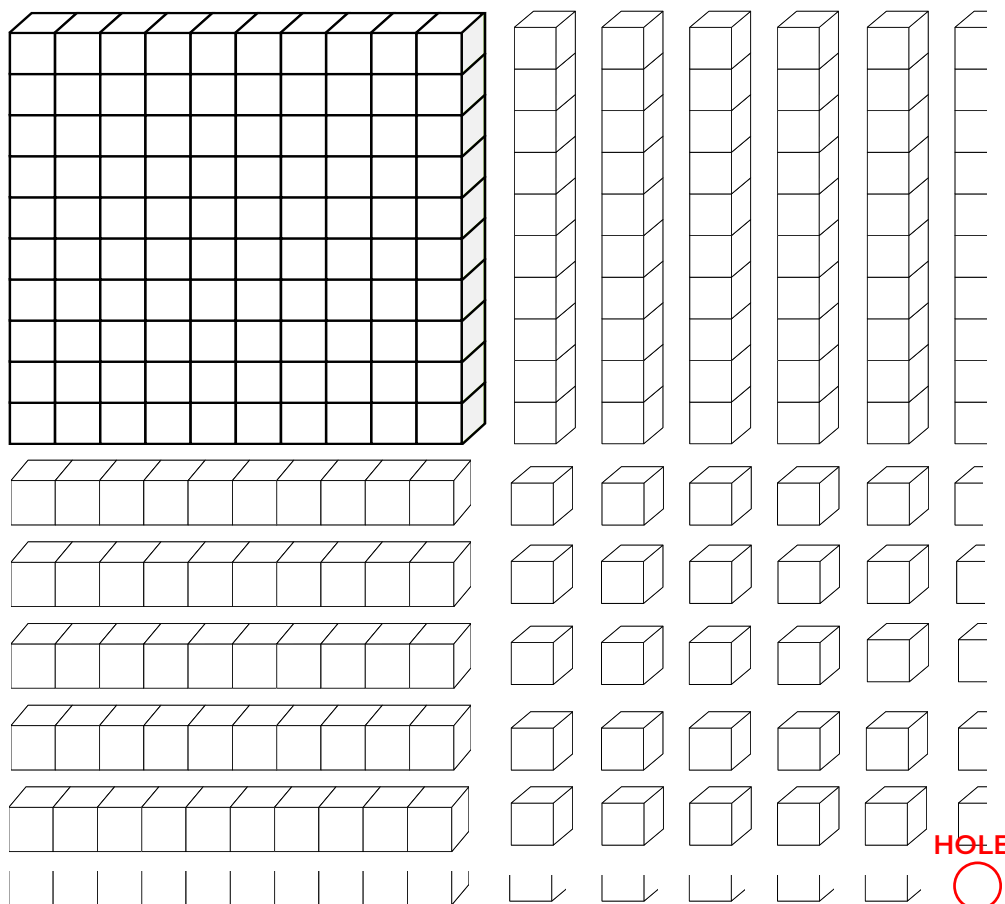
PART TWO
PROBLEM SCORING:
2 POINTS

THIS IS PART TWO OF A TWO-PART PROBLEM.

YOUR TASK:

USING BASE-TEN BLOCKS, CREATE A GEOMETRIC MODEL FOR THE

$\sqrt{250}$ TO AT LEAST THE HUNDREDTHS PLACE. THE MORE PRECISE, THE BETTER!



$$15 \frac{25}{30} \approx 15.83$$

$$\sqrt[2]{250} \approx 15.81$$

ALL FOR ONE

PROBLEM SCORING:
3 POINTS

PLACE A DIGIT (1 TO 9 ONCE EACH) INTO A STAR SO THAT THE FRACTIONS SUCCESSFULLY SUM TO ONE.

$$\frac{\text{star}}{\text{star} \times \text{star}} + \frac{\text{star}}{\text{star} \times \text{star}} + \frac{\text{star}}{\text{star} \times \text{star}} = 1$$

1	2	3	4	5	6	7	8	9
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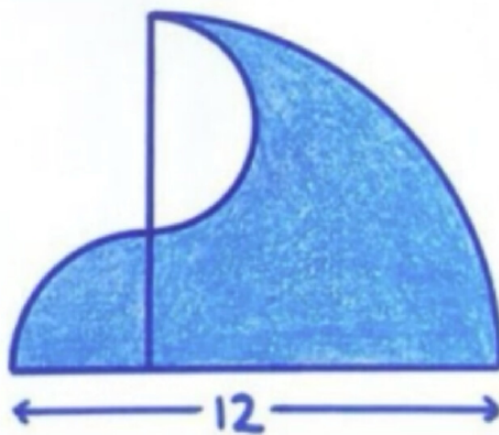
SOLUTION:

$$\frac{5}{8 \times 9} + \frac{1}{3 \times 6} + \frac{7}{2 \times 4} = 1$$

SHADY CIRCLE

PROBLEM SCORING:
4 POINTS

THE FIGURE BELOW CONTAINS TWO QUARTER CIRCLES AND A SEMICIRCLE. WHAT'S THE AREA OF THE BLUE-SHADED REGION?



- THE MASTER TEACHER HAS TWO PREDETERMINED HINTS FOR THIS PROBLEM.
- EACH HINT WILL DEDUCT ONE POINT FROM THE POSSIBLE POINTS FOR THIS PROBLEM.
- REPORT TO THE MASTER TEACHER IF YOU NEED A HINT.
- IF YOU DO NOT NEED A HINT, REPORT YOUR SOLUTION.

SOLUTION = 18π

SCHOOL OF PERCENTAGES

PROBLEM SCORING:
2 POINTS



- THE NUMBER OF STUDENTS AT ANDERSON STREET SCHOOL IS 240% OF THE NUMBER OF STUDENTS AT THE PHILLIPS SCHOOL.
- THE NUMBER OF STUDENTS AT ANDERSON STREET SCHOOL IS ONLY 60% OF THE NUMBER OF STUDENTS AT MIMS' SCHOOL.
- WHAT COULD THE NUMBERS AT EACH SCHOOL BE?
- WHAT IS THE FRACTIONAL RELATIONSHIP BETWEEN THE MIMS SCHOOL AND PHILLIPS SCHOOL?

SOLUTION:

- THE FRACTIONAL RELATIONSHIP IS $\frac{M}{P} = \frac{4}{1}$
- THERE ARE MANY POSSIBLE SOLUTIONS FOR THE NUMBER OF STUDENTS AT EACH SCHOOL. ONE POSSIBLE SOLUTION:
 - PHILLIPS = 20
 - MIMS = 80
 - ANDERSON = 48

THE RACE

PROBLEM SCORING:
2 POINTS

There once was a speedy hare who bragged about how fast he could run. Tired of hearing him boast, Slow and Steady, the tortoise, challenged him to a race. All the animals in the forest gathered to watch.

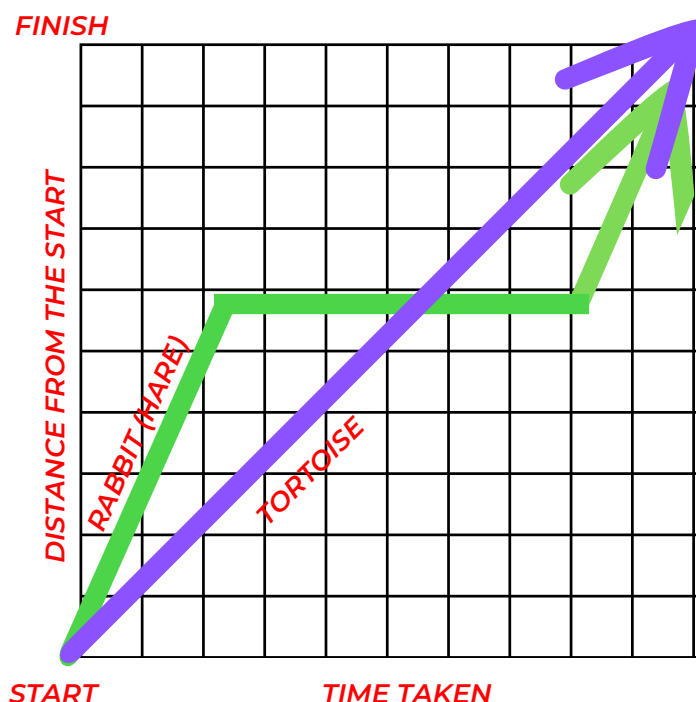
Hare ran down the road for a while and then paused to rest. He looked back at Slow and Steady and cried out, "How do you expect to win this race when you are walking along at your slow, slow pace?"

Hare stretched himself out alongside the road and fell asleep, thinking, "There is plenty of time to relax." Slow and Steady walked and walked. He never, ever stopped until he came to the finish line.

The animals who were watching cheered so loudly for Tortoise, they woke up Hare. Hare stretched and yawned and began to run again, but it was too late. Tortoise was over the line. After that, Hare always reminded himself, "Don't brag about your lightning pace, for Slow and Steady wins the race!"

Your Task:

Draw a graph that represents the race between the tortoise and the hare. Be sure to label the parts of your graph. **SOLUTION:**



KNOW YOUR ABC'S

PROBLEM SCORING:
2 POINTS

GIVEN: $5A = 7B = 9C$

WHAT IS THE RATIO $A : B : C$

SOLUTION:

$$63 : 45 : 35$$

AND ANY MULTIPLES:

$$126 : 90 : 70$$

$$189 : 135 : 105$$

ETC...

**THAT'S AN
ODD ONE**

PROBLEM SCORING:
2 POINTS

**HOW MANY FOUR-DIGIT ODD NUMBERS CAN BE FORMED
USING**

0 1 2 3 4

AS DIGITS?

(REPETITION OF DIGITS IS ALLOWED.)

SOLUTION:

$(4)(5)(5)(2) = 200$ NUMBERS

QUICKONOR MATH

LEVEL SCORING:
1 POINT

LEVEL ONE

SOLUTION GRID:

$$\begin{array}{c} 49 \\ \hline 7 \mid \begin{array}{c} + \\ \text{OR} \\ \times \end{array} \mid 7 \end{array}$$

$$\begin{array}{c} 19 \\ \hline 8 \mid \begin{array}{c} + \\ \text{OR} \\ \times \end{array} \mid 11 \end{array}$$

$$\begin{array}{c} 88 \\ \hline 8 \mid \begin{array}{c} + \\ \text{OR} \\ \times \end{array} \mid 11 \end{array}$$

$$\begin{array}{c} 21 \\ \hline 17 \mid \begin{array}{c} + \\ \text{OR} \\ \times \end{array} \mid 4 \end{array}$$

$$\begin{array}{c} 39 \\ \hline 13 \mid \begin{array}{c} + \\ \text{OR} \\ \times \end{array} \mid 3 \end{array}$$

$$\begin{array}{c} 68 \\ \hline 17 \mid \begin{array}{c} + \\ \text{OR} \\ \times \end{array} \mid 4 \end{array}$$

$$\begin{array}{c} 14 \\ \hline 7 \mid \begin{array}{c} + \\ \text{OR} \\ \times \end{array} \mid 7 \end{array}$$

$$\begin{array}{c} 16 \\ \hline 13 \mid \begin{array}{c} + \\ \text{OR} \\ \times \end{array} \mid 3 \end{array}$$

OPERANDS:

3	4	7	7
8	11	13	17

QUICKONOR MATH

LEVEL SCORING:
2 POINTS

LEVEL TWO

SOLUTION GRID:

$$\begin{array}{c} 10 \\ \hline 2 \mid \begin{array}{c} + \\ \text{OR} \\ \times \end{array} \mid 8 \end{array}$$

$$\begin{array}{c} 15 \\ \hline 3 \mid \begin{array}{c} + \\ \text{OR} \\ \times \end{array} \mid 5 \end{array}$$

$$\begin{array}{c} 12 \\ \hline 3 \mid \begin{array}{c} + \\ \text{OR} \\ \times \end{array} \mid 4 \end{array}$$

$$\begin{array}{c} 7 \\ \hline 3 \mid \begin{array}{c} + \\ \text{OR} \\ \times \end{array} \mid 4 \end{array}$$

$$\begin{array}{c} 8 \\ \hline 3 \mid \begin{array}{c} + \\ \text{OR} \\ \times \end{array} \mid 5 \end{array}$$

$$\begin{array}{c} 16 \\ \hline 2 \mid \begin{array}{c} + \\ \text{OR} \\ \times \end{array} \mid 8 \end{array}$$

OPERANDS:

2	3	3
4	5	8

QUICKONOR GAME

LEVEL SCORING:
2 POINTS

LEVEL THREE

SOLUTIONS GRID:

$$\begin{array}{r} 231 \\ \hline 3 \mid \begin{array}{c} + \\ \text{OR} \\ \text{X} \end{array} \mid 77 \end{array}$$

$$\begin{array}{r} 102 \\ \hline 6 \mid \begin{array}{c} + \\ \text{OR} \\ \text{X} \end{array} \mid 17 \end{array}$$

$$\begin{array}{r} 13 \\ \hline 5 \mid \begin{array}{c} + \\ \text{OR} \\ \text{X} \end{array} \mid 8 \end{array}$$

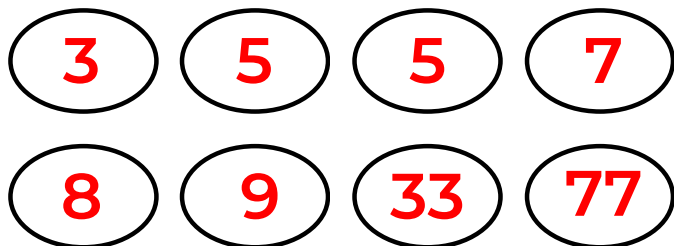
$$\begin{array}{r} 80 \\ \hline 3 \mid \begin{array}{c} + \\ \text{OR} \\ \text{X} \end{array} \mid 77 \end{array}$$

$$\begin{array}{r} 40 \\ \hline 5 \mid \begin{array}{c} + \\ \text{OR} \\ \text{X} \end{array} \mid 8 \end{array}$$

$$\begin{array}{r} 297 \\ \hline 9 \mid \begin{array}{c} + \\ \text{OR} \\ \text{X} \end{array} \mid 33 \end{array}$$

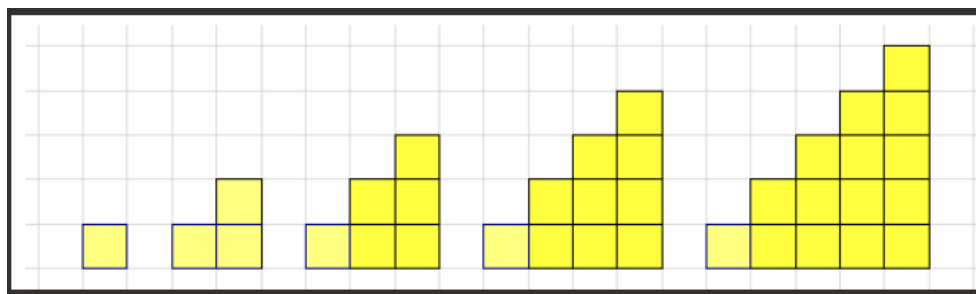
$$\begin{array}{r} 42 \\ \hline 9 \mid \begin{array}{c} + \\ \text{OR} \\ \text{X} \end{array} \mid 33 \end{array}$$

$$\begin{array}{r} 23 \\ \hline 6 \mid \begin{array}{c} + \\ \text{OR} \\ \text{X} \end{array} \mid 17 \end{array}$$



PATTERNS

PART ONE
PROBLEM SCORING:
2 POINTS



- THE FIGURE ABOVE REPRESENTS STAGES 1 THROUGH 5 OF A NUMBER PATTERN.
- GENERATE A FORMULA THAT WILL DETERMINE THE NUMBER OF BLOCKS NECESSARY TO BUILD THE NTH CASE FOR THE GROWING SHAPES. BE PREPARED TO JUSTIFY EACH ASPECT OF YOUR FORMULA WITH RESPECT TO THE GROWTH OF THE SHAPES OR THE STRUCTURE OF THE GEOMETRIC ASPECTS OF THE SHAPES.

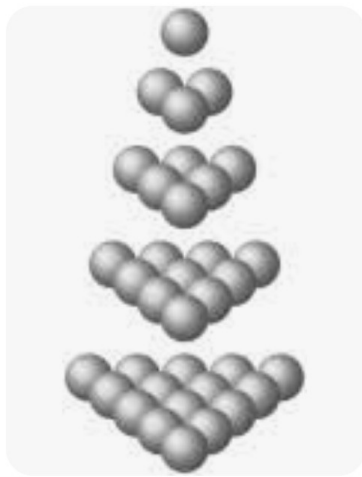
SOLUTION:

$$\text{NTH TRIANGULAR NUMBER} = \frac{n(n+1)}{2}$$

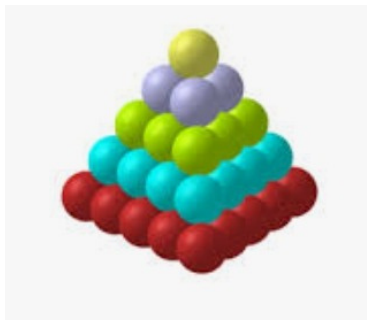
PATTERNS

PART TWO
PROBLEM SCORING:
2 POINTS

CONGRATULATIONS!
YOU COMPLETED PART ONE!



- THE PATTERN OF NUMBERS FROM PART ONE IS THE TRIANGULAR NUMBERS.



- THE SUM OF THE TRIANGULAR NUMBERS FORMS THE TETRAHEDRAL NUMBERS.
- THE TETRAHEDRAL NUMBER MODEL IS CREATED BY STACKING THE TRIANGULAR NUMBERS.

YOUR TASK:
HOW MANY LAYERS ARE THERE TO REACH THE TETRAHEDRAL NUMBER, 2024?

SOLUTION:

$$n = 22$$

NRICH TASK

PROBLEM SCORING:
3 POINTS

POSSIBLE SOLUTION:

EVEN NUMBERS	10	16	20	2	18
ODD NUMBERS	55	<u>9</u>	35	11	21
NUMBERS MORE THAN 20	36	25	45	23	24
NUMBERS LESS THAN 20	<u>6</u>	4	5	7	12
FACTORS OF 60	15	1	30	3	60

TRIANGULAR NUMBERS	SQUARE NUMBERS	MULTIPLES OF 5	PRIME NUMBERS	MULTIPLES OF 3
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NRICH TASK

PROBLEM SCORING:
3 POINTS

POSSIBLE SOLUTION:

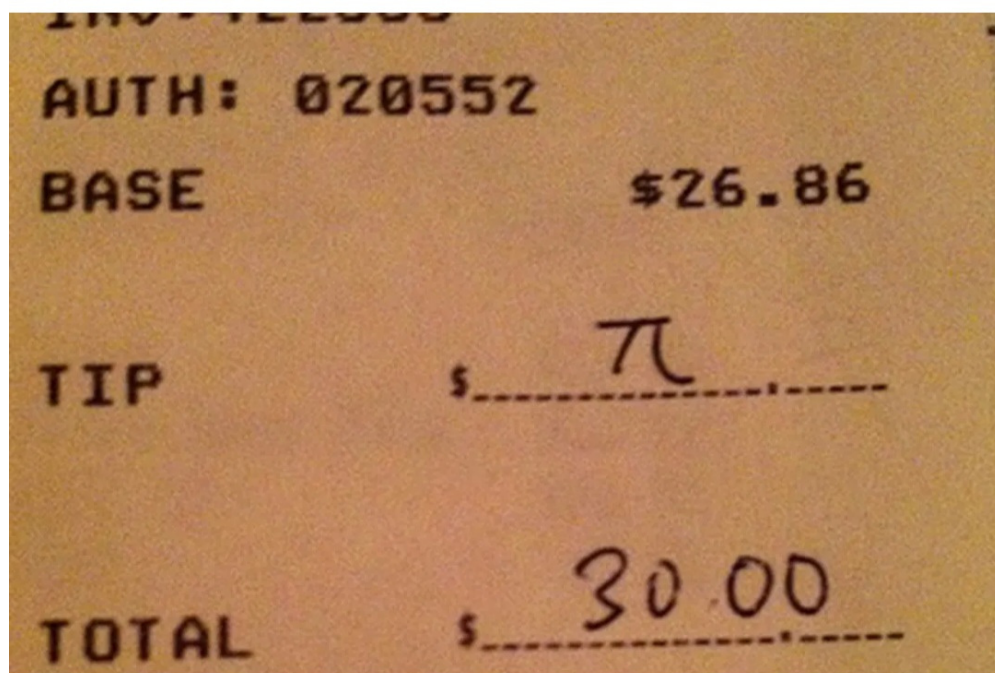
PRIME NUMBERS	3	23	11	7	2
TRIANGULAR NUMBERS	<u>6</u>	21	55	15	10
MULTIPLES OF 3	12	24	45	<u>9</u>	18
SQUARE NUMBERS	4	25	1	16	36
MULTIPLES OF 5	30	60	35	5	20

FACTORS OF 60	NUMBERS MORE THAN 20	ODD NUMBERS	NUMBERS LESS THAN 20	EVEN NUMBERS
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TIE-BREAKER PI TIP

THIS IS AN IMAGE OF A RECEIPT FLOATING ON THE INTERNET. A MATH GEEKS' DREAM TIP! BUT WAS THE SERVER PLEASED?

WHAT PERCENTAGE IS THE TIP OF THE BASE CHARGE?



SOLUTION:

$$\frac{3.14}{26.86} \times 100 \approx 11.69\%$$