

Click on the placement test:

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MSA PLACEMENT TEST(Arithmetic Proficiency)

Answer as many questions as you can.
Reduce all fractions to lowest terms.

Name: _____ Grade: _____ Date: _____

Write your answer and show your work in the space below each question. Clearly indicate your final answer by drawing a box around it.

1. Calculate $315.2 - 177.5$

2. What is 0.875 as a fraction (don't forget to reduce your answer to its lowest terms)

3. Calculate $2\frac{4}{7} \times 4\frac{2}{3}$

4. If April has a \$10 bill and apples cost \$1.35, how many apples can she buy and how much will she have left over?

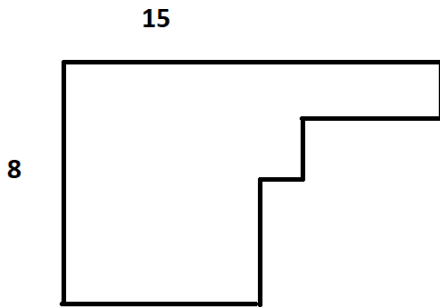
5. May gets 18 questions right on a test with 25 questions. What percentage did she get?

6. June buys a dress for \$85. There is a sales tax of 7%. How much did she have to pay?

7. Julie has \$12.60 and Augustus has \$4.80. How much should Julie give to Augustus so they will have the same amount?

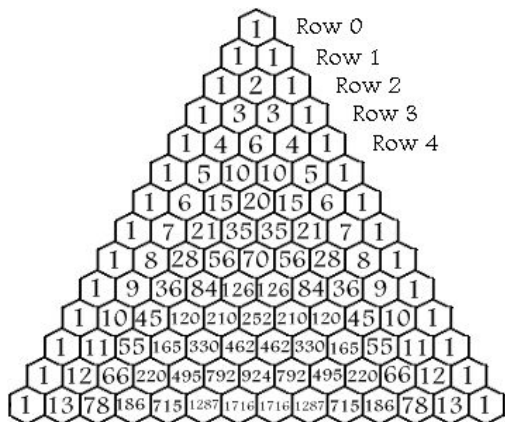
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8. Ellen worked on questions in her mathematics book, starting at the beginning of page 82 and finishing at the end of page 101. How many pages did she complete?

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9. Find the perimeter of this shape:



-
10. Each plant in John's garden has exactly 5 leaves or exactly two leaves and one flower. In total, the plants have 6 flowers and 32 leaves. How many plants are growing in the garden?
-

Pascal's Triangle



MSB PLACEMENT TEST

Answer as many questions as you can.
Reduce all fractions to lowest terms.

Name: _____ Grade: _____ Date: _____

Write your answer and show your work in the space below each question. Clearly indicate your final answer by drawing a box around it.

- There are 20 people at the Smith family reunion. If each person hugs all the other people once, how many hugs will there be?

- The 5-digit number $6836N$ is divisible by 9. What does the digit N represent?

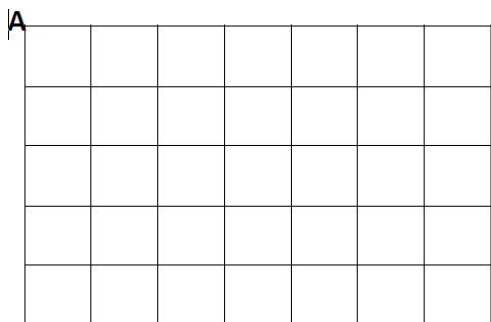
- Find the units digit of 2^{2022}

- Ben spent one-fifth of his money buying a notebook for class. He spent another half of what was left for a haircut. Then, he bought lunch for \$10. When he got home, he had \$2 left. How much did he have originally?



5.

Find the number of pumpkins in (a) the 43rd image. (b) the n th image.



6.

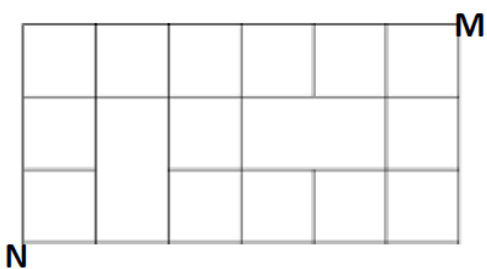
How many different paths are there to go from point A to point B if you can only go down and to the right?

7. If you flip a quarter 9 times, in how many ways can you get 5 tails?

M
 A A
 T T T
 H H H H
 C C C C C
 I I I I I I
 R R R R R R R
 C C C C C C C
 L L L L L L L L
 E E E E E E E E E

8. In how many ways can you spell MATHCIRCLE if you can only go down and immediately left or right?

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9. In how many ways can the letters of the word CIRCLE be arranged?



10. How many different paths are there to go from point N to point M if you can only go up or to the right?

MSC PLACEMENT TEST

Answer as many questions as you can.
Reduce all fractions to lowest terms.

Name: _____ Grade: _____ Date: _____

Write your answer and show your work in the space below each question. Clearly indicate your final answer by drawing a box around it.

1. What are the first 10 triangular numbers?

2. Using Fermat's Little Theorem, find $128^{129} \pmod{17}$. Show your work.

3. Convert 130_6 to base 10.

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4. The sum of two numbers is 9 and their product is 12. What is the difference of the two numbers?

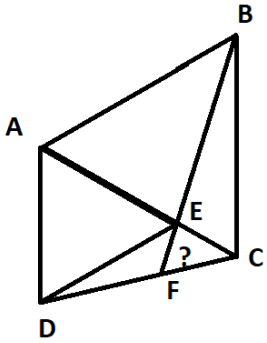
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5. What is the smallest 5-digit integer divisible both by 8 and 9?

6. $452x8$ is divisible by both 3 and 8. Find a possible value for x .

7. Of the 30 people on Anna's swim team, there are twice as many people who swim freestyle as backstroke. If there are 6 students who swim both freestyle and backstroke, and 3 students who swim neither freestyle nor backstroke, how many students swim backstroke?

8. How many different sets of 3 books can be chosen from a shelf of 20?

9. $\triangle ABC$ and $\triangle AED$ are equilateral. Calculate $m\angle EFC$ (Hint: Extend DE to meet BC at G. What kind of quadrilateral is DABG? What can you say about triangles BGE and DFE?).



10. If you flip a coin 8 times, how many outcomes are possible? How does your answer relate to Pascal's Triangle?

HSA PLACEMENT TEST(Algebra Proficiency)

Answer as many questions as you can.
Reduce all fractions to lowest terms.

Name: _____ Grade: _____ Date: _____

Write your answer and show your work in the space below each question. Clearly indicate your final answer by drawing a box around it.

1. Solve $(x - 2)(x + 3) = 4$.

2. Simplify $\frac{x}{1 + \frac{1}{x}}$.

3. What is the domain of $f(x) = \sqrt{x + 2}$?

4. Solve $|x - 2| \leq -2$

5. Write $y = 2x^2 - 4x + 7$ in vertex form.

6. Factor $a^4 - 1$ completely.

7. Calculate $(3\sqrt{2})^2 - (2\sqrt{5})^2$, showing your work.

8. If $f(x) = \frac{x+2}{x-1}$,

(a) Calculate $f(3)$

(b) Simplify $f(x+1)$

(c) Find $f^{-1}(x)$

9. It takes John 2 hours to swim against the current from a point A to a point B, which is 4 miles away. It takes him 48 minutes to swim back to A (with the current). What is the speed of the current?

10. The price of bread increases by 12% one year and by 8% the next year. What is the percentage increase over the two-year period?

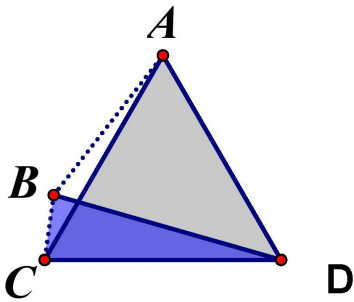
HSB PLACEMENT TEST

Answer as many questions as you can.
Reduce all fractions to lowest terms.

Name: _____ Grade: _____ Date: _____

Write your answer and show your work in the space below each question. Clearly indicate your final answer by drawing a box around it.

1. $\triangle ADC$ is equilateral and $\triangle DBC$ is isosceles. Calculate $\angle ABC$:



-
2. Denote the floor of x by $\lfloor x \rfloor$.

Compute:

$$\lfloor \sqrt{1} \rfloor + \lfloor \sqrt{2} \rfloor + \dots + \lfloor \sqrt{2020} \rfloor + \lfloor \sqrt{2021} \rfloor$$

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3. Determine the number of terminating zeroes in $8000!$

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4. Euclid's Formula is $(m^2 - n^2)^2 + (2mn)^2 = (m^2 + n^2)^2$ and is used for generating Pythagorean Triples. What values of m and n should be used to generate the following Pythagorean Triples?

(a) 16,30,34

(b) 10,24,26

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5. There are two Pythagorean Triangles that have r , the radius of the inscribed circle, equal to 5. What are they? Which one has a bigger area?

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6. Find the remainder when $27!$ is divided by 29 (Hint: use Wilson's Theorem).

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7. In $\triangle ABC$, $AB = 10$, $BC = 13$, $CA = 13$, and \overline{DC} and \overline{EA} are the altitudes from C and A , respectively. Find DE .
-

8. Solve in the naturals: $\frac{1}{x} + \frac{1}{y} + \frac{1}{z} = 1$

9. If x and y are chosen randomly so that $2 \leq x \leq 6$ and $3 \leq y \leq 6$, find the probability that $x + y \leq 9$.

10. Use the Chinese Remainder Theorem to find the smallest positive solution to this system of congruences:

$$x \equiv 2 \pmod{3}$$

$$x \equiv 3 \pmod{5}$$

$$x \equiv 2 \pmod{7}$$

HSC PLACEMENT TEST

Answer as many questions as you can.
Reduce all fractions to lowest terms.

Name: _____ Grade: _____ Date: _____

Write your answer and show your work in the space below each question. Clearly indicate your final answer by drawing a box around it.

1. A parallelogram is defined as a quadrilateral with two pairs of parallel sides. Using vectors, derive the following results:
 - (a) The opposite sides are congruent
 - (b) Diagonals bisect each other.

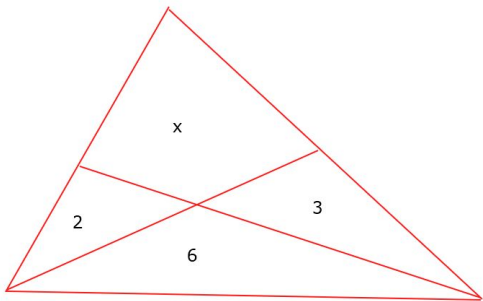
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2. A repunit is a number consisting entirely of 1s. For example, 1, 11, 111, etc. are repunits. Prove that if n is not divisible by 2 or 5, then there is a repunit divisible by n .

3. The Fibonacci sequence is defined recursively via $F_0 = 0, F_1 = 1, F_{n+2} = F_{n+1} + F_n$. Prove that

$$F_1 + F_3 + \cdots + F_{2n-1} = F_{2n}$$

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4. If the lengths of the bases of a trapezoid inscribed in a circle are 10 and 20, and the length of one of the legs is $\sqrt{89}$, find the length of a diagonal.

5. Find the area x .



6. Prove that for non-negative x, y, z , if $xyz \geq 1$, then $(x + 1)(y + 1)(z + 1) \geq 8$.

7. How many 4-letter words can be formed such that each word has 4 different letters in increasing alphabetical order, such as AFNZ?

-
8. Factor completely: $181^2 + 457^2 + 362 \cdot 457 - 362^2$

9. How many solutions does the equation $x + y + z = 10$ have in non-negative integers if $x \leq 3, y \leq 6, z \leq 9$?

-
10. Find the 3rd degree monic polynomial with roots r, s, t which satisfies

$$\begin{aligned}\frac{1}{r} + \frac{1}{s} + \frac{1}{t} &= \frac{5}{8} \\ \frac{1}{rs} + \frac{1}{rt} + \frac{1}{st} &= \frac{3}{8} \\ \frac{1}{rst} &= \frac{1}{8}\end{aligned}$$

COLLEGE BRIDGE PLACEMENT TEST

Answer as many questions as you can.
Reduce all fractions to lowest terms.

Name: _____ Grade: _____ Date: _____

Write your answer and show your work in the space below each question. Clearly indicate your final answer by drawing a box around it.

1. Write i^i in the form $a + bi$, where a and b are real and $i = \sqrt{-1}$

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2. Let a_1, a_2, \dots be a sequence defined by $a_1 = \frac{1}{5}$ and

$$a_n = \frac{a_{n-1}}{1 + 3a_{n-1}}$$

for $n \geq 2$. Find a_{1000} .

3. A 9-digit number is formed using the digits 1, 2, 3, 4, 5 so that the product of all digits is 1920. How many ways are there to do this?

4. Two numbers x and y are chosen at random without replacement from the set $\{1, 2, 3, 4, \dots, 5k\}$. What is the probability that $x^4 - y^4$ is divisible by 5 in terms of n ?