General Directions for the Problem Sets:

The purpose of these problem sets is threefold:

a. To review, enhance and make connections with your past knowledge. Students at IMSA come with a wide variety of mathematical backgrounds. Because you were placed in Mathematical Investigations II, certain assumptions about your algebraic skills were made. During the first several weeks of the course some of these skills will be reviewed through the Problem Sets. Focused *algebra review* problems will be included. If there are any of these problems that you have never seen or are rusty on, it is your responsibility to let your teacher know and to seek outside help to solidify that skill. You may also see problems marked "NC," for "no calculator." This indicates that we expect you to be able to complete the problem without the use of a calculator.

b. To work with current concepts being discussed in class in both familiar and new contexts.

c. To preview ideas and techniques that will become important in the near future.

In addition, some ideas will be introduced/explained in the problem sets. Usually the first time such an explanation is presented it will appear in a box. You should be sure to pay special attention to such boxed directions, as you will be expected to be able to **use that information from then on**.

Detailed - Correct - Neat & Legible Solutions are to be written on the answer sheets provided and turned in by the due date. You are permitted to obtain help from books, your teacher, other students, or the math department instructional aides in order to clarify anything that you don't understand, but the work must be your own. Be sure to review anything that you needed help with, in order to be sure that you can do it by yourself. Unless told otherwise, give exact answers whenever possible.

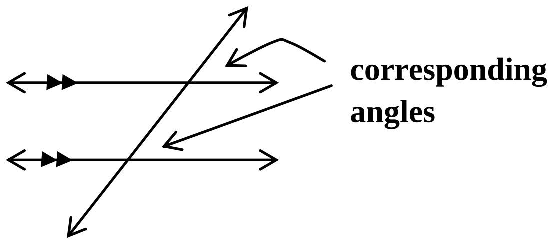
You are ultimately held accountable for being able to perform any tasks related to the problems.

The Problem Sets are to be completed along with your regular math class homework, which will be shorter and with a different emphasis than the Problem Sets. Budget your time to allow for you to get help when needed, **before the due date**. It does you no good to rush through these problems the night before they are due, because some of the concepts will be needed during the class lessons that meet before the due date.

EACH Problem Set is due the following B-Day.

All answers should be exact whenever possible.
Approximated answers should be rounded to four significant digits unless otherwise stated in the problem.

1) If two lines are parallel, and crossed by a third line, called a transversal, then corresponding angles are equal in measure.

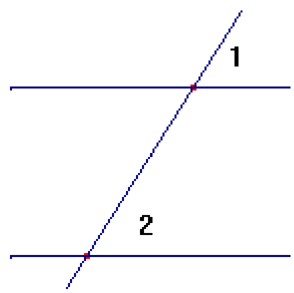


Two parallel lines with a transversal is shown:

Let $m\angle 1 = 5x + 7$

Let $m\angle 2 = 11x - 35$

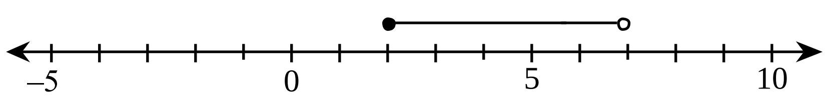
Solve for x.



2)

The interval on a number line starting at 2 and going up to but not including 7 can be represented in a number of ways.

- As an inequality: $2 \le x < 7$
- As a graph:



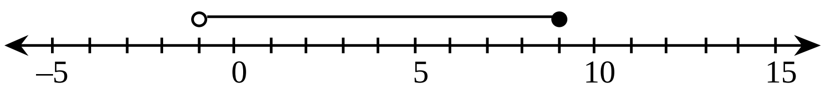
- As a set: {x: $x \ge 2$ and x < 7} or {x: $2 \le x < 7$ }
- As an interval: [2, 7)

For each notation there is a way of indicating that the number 2 **is** included while the number 7 **is not**. A solid dot on a graph **includes** the point, an open circle **does not**. A square bracket in interval notation is **inclusive** the curved parenthesis **is not**.

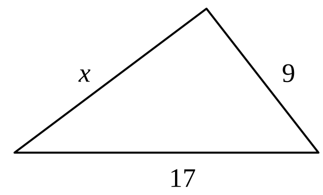
a. Graph: $x : x \ge -2$ and $x < 3$.

b. Write $-5 < x \le 10$ in interval notation.

c. Represent the numbers graphed below in set notation.



3) The length of side x in the triangle must be between what two values?
(min. length < *x* < max. length)



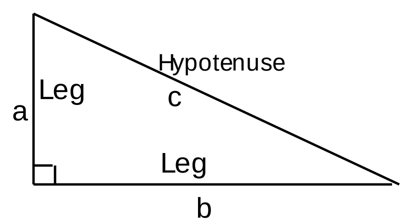
4)

The Theorem of Pythagoras is perhaps the most important fact in Geometry and Trigonometry.

In any right triangle, with

hypotenuse c and legs a and b:

$a^2 + b^2 = c^2$



a) If $a = 24$ and $c = 25$, find *b*.
b) If $a = 11$ and $c = 61$ find *b*.
c) If $a = 15$ and $b = 10$ find *c*. (Remember, give exact answer in simplified form.)

A classic counting problem is called the *Handshake Problem*. If there are n-people

in a room and everyone shakes hands once with everyone else, how many handshakes occurred? In counting, you need to be careful not to count the same handshake twice. For example, if two people are in the room, there is only one handshake. If three people are in the room, how many handshakes will occur? What about four people? This problem occurs in a variety of contexts such as the problem below.

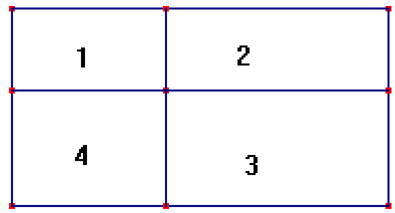
5) The Big Ten has 11 teams. For basketball, each team hosts a home game with every other team. How many conference games are played in total during the season?

6) A rectangle is partitioned into four rectangles, each of whose sides are integer values. Find the area of the fourth rectangle, if

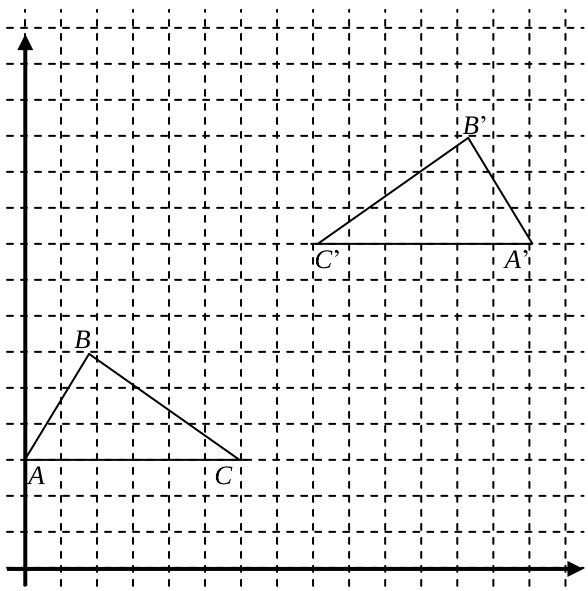
a) Area 1 = 15, Area 2 = 21, Area 3 = 63
Show your work.

b) Give a second solution, if possible, to this problem.

Explain.



Describe how to move ΔABC onto $\Delta A'B'C'$.



8) $\triangle$ ABC above is translated 5 units to the left and 3 units up to $\Delta A''B''C''$.

a. Write the *vertex matrix* for $\Delta A''B''C''$.

b. Write the *matrix equation* which describes this transformation.

9)

The *mean* of a set of K numbers is the sum of the numbers divided by K. The

mean is sometimes called the *Arithmetic Mean*. The median of a set of K numbers is the middle value when the numbers are arranged from lowest to highest or highest to lowest. If there are two middle values, the mean of those two values will be the median.

For the set of numbers 21, 3, 30, 9, 12

a) Give the mean.
b) Give the median.
c) Two numbers are added to this set so that the mean and the median do not change. In general, what must be true of any two numbers that have this property? Explain.

10)

Probability is simply a fraction that relates $\dfrac{\text{number of "winners" or "favorable events"}}{\text{total number of possibilities}}$

a) A number is randomly selected from the set {1, 2, 3, 4, 5, . . . , 50}. What is the probability it is a prime number? (Remember, 1 is not a prime number.)
b) If a letter is randomly chosen from the letters in the name HERMIONE, what is the probability that it will be a consonant?

11) The **Arithmetic Mean** (AM) of a and b is $\dfrac{a+b}{2}$. The **Geometric Mean** (GM) of a and b is $\sqrt{a \cdot b}$.

a) Find the AM and the GM of 18 and 255.
b) Find the AM and the GM of $\dfrac{1}{3}$ and $\dfrac{1}{12}$.

c) Find the AM of the GM of 9 and 16 and the GM of 18 and 2.

12) If $a + b = 15$ and $a \cdot b = 47$

Use $(a + b)^2$ to find $a^2 + b^2$

13) The diagonal of a square is 12 cm. Find the width of the square.

14) $\left(\dfrac{a^2b^3c^6}{a^5b^4c^3}\right) = \dfrac{(abc)^3}{a^m b^n c^q}$ Find (m, n, q).

Non-Calculator Problems: Complete problems 15-17 *without* using your calculator. As always, you must show all work to receive full credit. In future problem sets, non-calculator will be indicated by NC next to the problem.

15) **NC** Combine: $3\begin{bmatrix} 3 & 6 \\ 4 & 5 \end{bmatrix} - 2\begin{bmatrix} -5 & 6 \\ -9 & 11 \end{bmatrix} =$

16) **NC** Solve for *x*:

a) $\frac{x-3}{x+3}=\frac{5}{9}$ b) $\frac{x-3}{x+3}=\frac{9}{5}$

17) **NC** Simplify each expression completely:

a) $(2x-1)(5x+2)-(3x+2)(x+5)$ b) $(2x+2)+4(3x-1)-4(2x-3)$

18)

Scientists are always interested in the uncertainty of all measurements they make. One method used to indicate the degree of certainty is referred to as "significant figures". The IMSA science departments use the following rules to determine the number of significant figures:

- All non zero digits are significant.

  12.345 has 5 significant digits.

- All zeros between two significant digits are significant.

  200.0701 has 7 significant digits.

- The first significant digit in a number cannot be a zero. This means that leading zeros are not significant.

  0.00034 has 2 significant digits.

- The last significant digit in a whole number cannot be a zero. This means that trailing zeros in a whole number are not significant.

  123000 has 3 significant digits.

- If a non-significant zero is intended to be considered significant, this will be indicated with a bar placed above it.

  $200\bar{0}0$ has 4 significant digits.

- All zeros to the right of a decimal point and to the right of a nonzero digit are significant.

  3.12000 has 6 significant digits.

How many significant figures are in these numbers?

a. 23050 b. 0.0440 c. 806

d. 605.0 e. $5.363 \cdot 10^4$

19) **Graphing calculator problem**. This problem requires you to use your calculator to evaluate functions and find points of intersection using the tools found in the graphing portion of your calculator under the math menu. As you progress through MI 2, the problem sets will develop a theme of using your calculator.

$f(x) = 1.2^{x}$ $g(x) = 2x^2 - 4x - 5$

a) Find the coordinates of the points on the graphs of *f* and *g* when $x = 2$. (2 decimals)

b) Find the points of intersection of *f* and *g* (2 decimals).

20) a) Graph and label on the same grid: $y = |x|$, $y = |x-4|$, and $y = |x+3|$.

b) Describe, in general terms, how the graph of $y = |x|$ is transformed to produce the graph of $y = |x-h|$.