Only multiply equalities when both the sides of inequality is +ve

Square root of x^2 = |x|

When DS asks for a combination of variables, don't solve for each variable, just extract out the value of equation.

When a value of a variable is sought and you are getting 2 values, then the answer of the problem would be no solution even after combination of the 2 statements

In DS questions for Inequality, it might happen that you have to check -ve and +ve sign of variables of given equation to arrive at a final answer.

x^2 - x means 0 < x < 1

* If you find difficult to simplify an expression then simply plug-in values of random numbers and you can check the result with all the answer choices you've got
* If the exponent is between 0 and 1 the number > than the original proper fraction

The retailer has less than twice as many radios as clocks in inventory.

r < 2c

Absolute equation both sides, consider only 2 cases ++ and +-

========================== Equations ====================

To solve quadratic equation without using formula : x^2 + bx + c

find the numbers, the sum of whom is -b and product is c

for example:

Consider the equation : x^2 + x - 12

Here we have to find the numbers whose sum is -b or -1 and product as -12. the solution is 3 and -4.

(x+y)^2 - (x-y)^2 = 4\*x\*y

(x+y+z)^2 = x^2 + y^2 + z^2 + 2(x\*y + y\*z + z\*x)

x^3 + y^3 = (x+y)(x^2 + y^2 - x\*y)

x^3 - y^3 = (x-y)(x^2 + y^2 + x\*y)

===============================================================

sq\_root(b^2 - 4\*a\*c) is called the discriminant in the equation. If it is 0, eqn has 1 solution, if > 0 then it gives 2 solution else eqn has no solution

For function problems, pick number and try out equations

when you do not know the sign of numbers, you cannot take reciprocals

if x < y then 1/x > 1/y either if both are +ve or both are -ve

Do not flip sign when one is +ve and other one is -ve

Taking squares:

if both sides positive raise the square and sign will remain the same

if both side -ve flip the sign.

If not sure whether number could be +ve or -ve, you cannot do squares

Square of odd is odd and even is even

=========== Ratio and Proportion ============

> If a/b = c/d = e/f, then (a+c+e)/(b+d+f)

> To calculate % change in 2 ratios, find % change in numerator and % change in denominator(This needs to be reverse calculated) and then use 100 as reference applying these % changes to get the result.

> If a > b then (a+k)/(b+k) < a/b and (a-k)/(b-k) > a/b. Similarly, if a < b, aforementioned equalities will be reversed.

> 2 similar products are sold. One at x% loss and other at x% profit. The result is loss of [x/10]^2%

> When amount left and amount sold is given with a given profit, then profit is (goods\_sold/goods\_left)\*100

> To find maxima of a quadratic equation, differentiate it and equate the differentiation to 0

=========== Time, Speed and Distance ========

> To convert a value from km/h to m/s, multiply the number by 5/18 and to do vice-versa, multiply by 18/5

> Use proportionality as the key idea to solve a problem based on T,S&D when one of the three things is constant

> To solve questions based on clocks, consider speed of minute clock as 60km/h while speed of hour hand as 5km/h and use relative speed of 55km/h to find the solution.

================= Combinatorics ==========

In problems where it is required to insert things in odd positions use the below depiction

| - | - | - | - | - |

e.g - 4 boys, 3 girls arrange with no girls together - 4! \* 5\*4\*3\*2\*1

Formula to find rank of a word in dictionary

Write the word and put its relevant alphabetical rank above it(which is relative to the given alphabets)

For example for "RANDOM" it will be - R(6), A(1), N(4), D(2), O(5), M(3)

for each word write the numbers of integers - smaller than that integer on the right - below that number.

For RANDOM it will be : 5, 0, 2, 0, 1, 0

The rank would be 1 + n!\*first\_number + (n-1)!\*second\_number + ...

For "RANDOM" - 1 + 5\*5! + 0\*4! + 2\*3! + 0\*2! + 1\*1! + 0\*0! = 1+600+12+1 = 614

Number of lines that can be drawn between set of n points = nC2

Number of triangles that can be drawn between set of n points = nC3

Number of circular arrangements for n things = (n - 1)!

Desc - Fix the position of 1 person and find the max permutation of left out people

If there is a question asking about the number possible with 2 conditions in that case consider individual case of one condition combination

==================== Fractions/Decimals =================

\* If there is increment of 25% in value for a given commodity over a period of n years, the resultant value will be :

(original\_value)\* (1.25)^n

\* Similarly, in case where value if being decremented, say by 20% use the below reverse addition form

(original\_value) \* (0.8)^n

\* Use the above method to solve questions like: A commodity price first incremented by 25%, then inc. by 40% and

finally decremented by 20%

The solution will be like : (original\_value)\*(1.25)\*(1.4)\*(0.8)

\* Incrementing the value of numerator and denominator by constant amount takes its value closer to 1 and vice versa.

\* Formula to find average speed - (2\*a\*b)/(a+b)

\* Rational number can be represented as a/b which can be written as terminating or repeating decimal. The numbers which cannot be represented in this way are called irrational numbers. such as pi, sq(2). There is no overlap between these sets. rational + irrational = real numbers

\* There are 25 primes between 1 and 100

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97

\* If n is a positive integer there is always a prime number p : n < p < 2n

\* If a number equals the sum of its proper divisors, it is said to be a perfect number. 6 = 1 + 2 + 3

\* if a is a factor of b and c, then a is a factor of (b+c)

\* A fraction will always yield a terminating decimal as long as the denominator has only 2 and 5 as its prime factors

\* In questions asking whether number can be limited to finite decimals check for '7' and '3' in denominator which should be eliminated to make this happen.

\*

--- Rules for Rounding Off -----

Rule I — When the figure next beyond the last figure or place to be retained is less than 5, the figure in the last place retained shall be left unchanged.

Rule II — When the figure next beyond the last figure or place to be retained is more than 5 or is 5 followed by any figures other than zeros, the figure in the last place retained shall be increased by 1. --> 13.455 --> 13.5

Rule III — When the figure next beyond the last figure or place to be retained is 5 alone or 5 followed by zeros only, the figure in the last place retained shall be (a) increased by 1 if it is odd and (b) left unchanged if even (zero would be regarded as an even number for this purpose).

13.45 -> 13.4, 13.75 -> 13.8

==================== Percentages ===========================

F = P ( 1 + r/n)^nt, where

F = Final value

P = Principal

r = annual interest rate

n = number of compounding periods per year

t = number of years

\* Fraction gets smaller when an integer is subtracted from numerator and denominator of the fraction.

**To find solutions to problem of equal installment over a period of time:**

Louie must repay the loan in three equal monthly payments. To the nearest dollar, how much does Louie have to pay each month

Let X be the amount paid after one installment. Then after 1 month, amount needs to be repaid is 1.p\*Principal-X. Keep multiplying with 1.p and subtracting X till last installment when it will be X which is left.

**Solution to equation of type of percentage tagging:**

2 categories. Some items of cat1 marked for cat2 and some items of cat2 marked for cat1, use matrix method.

==================== Word problems ===========================

Algebraic translations:

Using equations

Rates and Work

Make RT = D pattern for rate/distance problems.

For average speed calculation and all take distance of 100

Average speed of a person that walked to/ from for a distance with speeds x and y is 2\*x\*y/(x+y)

When dealing with tasks, take the task as 1 unit

\* Sometimes it is given that additional x% discount is given after $y, in that case consider only discount of x% not the discount % given if value bought/sold is below y

========================= Set =================================

\* For all evenly spaced set, the average equals - (first+last)/2

\* The sum of that set is (average)\*(numer\_of\_items)

\* If a given median is not integer then there are even number of elements for sure.

\* The product of k elements is always divisible by k!

\* x! is divisible by all integers up to and including x

\* For any consecutive set of odd number of integers, the sum is always divisible by number of elements.

\* Same is not applicable for set of even number of consecutive integers.

\* Weighted average is like giving unequal precedence to the numbers in the set, example:

m\*(a/(a+b)) + n\*(b/(a+b)) = x

\* For evenly spaced numbers mean and median are same and that set is in arithmetic series.

\* 1 unit of standard deviation from mean: mean-s\_d , mean+s\_d

\* Alligation and Mixture : use cross formula

A1 A2

\ /

A

/ \

N1 N2

======================== Number Properties =======================

* If a number is not a prime number then it is a composite number.
* All prime numbers are of the form: 6\*n-1 and 6\*n+1
* If 'n' is a positive number then there is always a prime 'p' such that n < p < 2\*n
* Number of factors of an integer : 300 - 2^2 \* 5^2 \* 3 --> (2+1)\*(2+1)\*(1+1) = 18
* To find HCF - Factorize the number and take out the number with common powers
* To Find LCM - Factorize and pick the maximum power of the prime numbers (factors)
* integer - |integer| = remainder/divisor
* To solve divisibility/remainder kind of question write the number as:
* Quotient \* Divisor + Remainder
* The number of distinct factors and sum of factors of a perfect square are always odd
* Take **‘0’, negatives and fractional numbers** into consideration as well while solving DS questions.
* Sum of first positive odd numbers – n^2
* Sum of first +ve even numbers – n\*(n+1)
* A fraction will be non-terminating only if denominator is of the form 2^m\*5^n. In question while determining this, do reduce the fraction to prime factors
* ‘1’ is a perfect square and perfect cube and also a factor of all the numbers.
* To find a number which is perfect square, Divide that number into factors and check if count of those factors is divisible by 2.
* H.C.F of (a^m-1) and (a^n-1) is given by (a^(H.C.F of m and n) -1 )
* n!+1 cannot be divisible by any number less than or equal to n
* Remainder is always non-negative. So, -32%7 will be 7\*(-5) + 3 is correct and 7\*(-4) – 4 is not
* if ‘m’ and ‘n’ are divisible by ‘d’ independently, then (m+n) and (m-n) are also divisible by ‘d’
* If ‘a’ is divisible by ‘b’ and ‘c’ by ‘d’, then ‘ac’ is divisible by ‘bd’
* Highest power of a factor ‘p’ that is contained in a number N : [N/p] + [n/p^2] + [N/p^3] …
* Sum of factors of a number : Let N = \*, Then their sum is : (x^0+x^1+x^2+…x^n)\*(y^0+y^1+y^2…+y^n)\*(z^0+z^1+z^2+…+z^n)
* Number of factors for the above equation = (a+1)\*(b+1)\*(c+1)
* Number of even factors = (2^1+2^2+2^3…) we have removed 2^0 for including only even numbers. So, formula will be (a)\*(b+1)\*(c+1)
* Number of odd number of factors = (1)\*(b+1)\*(c+1) wherein we have removed all factors of 2
* If p is a prime number then (p^2-1) will be divisible by 24.
* Process to convert a rational number with pure recurring decimal: For x.<digit\_1, digit\_2…digit\_n><digit\_1, digit\_2…digit\_n>… = x + n/99…n. So, for x.yyyy = x+y/9 and for x.yzyzyzyz = x + (Y\*z)/99
* For value between 0 and 1, squaring the number will reduce the value of number.
* Formula for finding H.C.F and L.C.M of a given rational number
* H.C.F of fraction = H.C.F. of numerator / L.C.M. of denominator
* L.C.M. of fraction = L.C.M. of numerator / H.C.F. of denominator
* If H.C.F. of ‘x’ and ‘y’ is ‘g’ then H.C.F. of (x, (x+y)) , (x, (x-y)), (x+y, x-y) is also g
* A composite number is a number which has at least one divisor apart from ‘1’ and itself.
* Two consecutive integers are co-prime, which means that they don't share ANY common factor but 1

Compound interest formula  
P\*( 1 + interest/C )^(time\*C) where C is the number of times compounded annually

|X| + |y| >= |x+y|

what is the remainder upon division -1 by 13? The answer to this question is 12: −1=13∗(−1)+12−1=13∗(−1)+12.

Relative prime numbers – Numbers which have unity as common factor. For Example – 25 and 49. If there are 2 relative prime numbers as denominators of 2 rational numbers, then addition/subtraction operation between those rational number cannot yield an integer.

2-consecutive numbers are always co-prime.

Two prime numbers with difference of 2 are called twin primes. e.g. 11 and 13, 17 and 19

A number is said to be perfect if sum of divisors (incl. number itself) is 2\*number

Product of any r consecutive number is divisible by r!

The difference between 2 numberd xy and yx is divisible by 9. e.g. 31-13 = 18%9 = 0

If ‘m’ and ‘n’ are 2 integers then (m+n)! is divisible by m! and n!

a^n/(a+1) will yield ‘a’ if ‘n’ is odd and ‘1’ if ‘n’ is even

For any natural number n^3-n is divisible by 6.

Remainder theorem:

(x\*y)%z = (x%z)\*(y%z)

In the above equation, we can use negative remainder too.

If we given an expression x\*y\*z… and asked to find last 2 digits then we can find it by dividing the number by 100 and taking its remainder.

e.g. 25^102 when divided by 17

=> (8^102)%7 => (512^34)%17 => (2^34)%17 => (-1)^8\*4/17 = 4

Also, We will have n^x as unit digit as n if ‘x’ is either divisible by 5 or 9.

To find the maximum power of a number that can divided a given number X. Find the power of largest prime in the divisor.

Like to find highest power of 63^n which can divide 13890! find the number of 7s in 13890 since 7 is highest prime in 63 and least repeated.

if sum of 2 primes is odd then one of the number is definitely will be 2

There are no guaranteed outcome in division operations so it can be odd,even or a decimal number

If |x| = x always, then x = 0

Specific to the case of 5, if there are 5 -ve integers in the set then there might be 0 in the set, so don't assume.

n! for arrangement of n things given all are unique and if there are some similar numbers also then the result will be n!/m! where m is the number of like things

\* GCF of number m and n X LCM of number m and n = m X n

\* All perfect squares have odd number of factors.

\* You can perform arithmetic on remainder itself:

\* If a number x leaves 5 as a remainder on division by 7 and y leaves remainder of 5 on divisible by 7. Then the total is : 10, correcting it will give: 10 - 7 = 3

If a number is given (variable) and another number is given + the LCM of both the numbers is given, to find the variable put both the number and the LCM in a table and factorize to find.

E <-- to find

45 - 5 X 9

225 - 5 X 5 X 9

Now to complete 225 E must contains two 5's and 0 or more 9's,

If it contains only 5's it can be 5 X 5 X 5 = 75

or 5 X 5 = 25

Sum of first n even numbers = n(n+1)

Sum of first n odd numbers = n^2

How to find tens digit of a number:

for 1, 3, 7, 9 - Convert number in such a way such that last digit of number is 1 then the tens digit will be the last digit of - first\_digit\_of\_base\*last\_digit\_of\_exponent

for 2, 4, 6, 8 - keep in mind 76\*xxx76 = zxy...76 and 24^any\_even\_power = xyz...76 and 24^odd\_power=24 .. here we will get exact last 2 digits

(1) if number's 10s digit is even, then last digit will always has to be 25.

(2) if number's 10s digit is odd, then last digit will always has to be in cyclic pattern of 25, 75,25,75 and so on...

\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Last digits of a product of integers are last digits of the product of last digits of these integers.

For instance last 2 digits of 845\*9512\*408\*613 would be the last 2 digits of 45\*12\*8\*13=540\*104=40\*4=160=60

\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Compound interest than compounds C times in a year, n is the duration and rate is interest rate

principal\* (1 + rate/C)^(n\*C)

|x| + |y| >= |x+y|

|x+y| > |x-y| only if x and y have same sign

Remainder:

in questions related to if a number divided by x leaves a remainder of a and y leaves remainder b. We can write the equation as xy + (first number common to both the equations)

In the questions which asks to find the remainder when dividing by 5, frame the equation as (x0 + p)^z now check what is the remainder when p^z will have when divided by 5. on expansion, this equation will have multiple of x0 except the last which will be p^z.

Any integer divided by a power of 2 or 5 will result in a terminating decimal

When the integer x is divided by the integer y, the remainder is 60. Which of the following is a possible

value of the quotient x/y?

x = ky + r ==> x/y = k + r/y ==> r/y = given options check if completely divisible : given were 15.15, 18.16 and 17.17 (incorrect)

\* Prime factors and normal factors are different.

Factorials:

Number of trialing 0s in a number:

n/5 + n/5^2 + n/5^3 + … n/5^k such that 5^k < n

It can be extended to find number of powers of a number p by replacing ‘5’ with ‘p’ in the above formula

Overlapping Problems:

In case 2-group is mentioned

AUBUC = A+B+C - ( A^B) – (A^C) – (B^C) + (A^B^C) + Neither

-----------------------<sum of 2 group overlaps>----(all three)

In case sum of EXACTLY 2 group is mentioned the formula will be come

AUBUC = A+B+C - ( A^B) – (A^C) – (B^C) - 2\*(A^B^C) + Neither

-----------------------<sum of 2 group overlaps>----(all three)

========= Modulus=======

For question involving finding out the number of solution to a equation which involves multiple Modulus based terms:

Solution : First, get value of x from each sub-equation so that value of that modulus becomes 0 if we plug-in the value of x, those values are called the critical values. One by one take that value of x and determine the sign of subequation by checking the sign of sub-equation inside the modulus. While solving change the sign of sub-equation and insert that value. Get the value of x and check if that falls in the range as specified by its sub-equation. If it doesn't fall in that put its value and get the outcome and that solution of x should satisfy the initial solution of the sub-equation was inserted.

This method is called the "critical values" method

like: |x+3| – |4-x| = |8+x| How many solutions will this equation have? It will have 0

Here, put values in the extreme and middle range of -3, 4, and -8 one-by-one and find the value of x, it won't satisfy the inserted value.

Range will be :

x<-8

-8<x<-3

-3<x<4

x>4

Taking range of -3 <= x <= 4

x+ will be positive and x-3 will be negative ..

eq becomes (x+2)=-(x-3)+1..

x+2=-x+3+1..

x=1.. valid value

b) two mods..

|x+2|=|x-3|+1..

critical values -2 and 3...

so regions are <-2, -2<=x<3, x>=3..

i) x<-2...

x+2 will be -ive and x-3 will be negative ..

eq becomes -(x+2)=-(x-3)+1.. both negative

-x-2=-x+3+1..... no values..

ii) −2<=x<3−2<=x<3..

x+2 will be positive and x-3 will be negative ..

eq becomes (x+2)=-(x-3)+1..

x+2=-x+3+1..

x=1.. valid value

iii)x>=3..

x+2 will be positive and x-3 will be positive ..

eq becomes (x+2)=(x-3)+1..

x+2=x-3+1..

no valid value..

so the solution is x=1

========== Sequence and Series ========

\* Sum of n terms is : a\*n + n\*(n-1)/2

\* A set of 3 consecutive number is divisible by 8 if middle number is odd number.

\* For any set of consecutive integers with an odd number of terms, the sum of the integers is always a multiple of the number of terms

============ Work/Rate Problems ============

In Work/rate problems, if equations are needed to be proved and numbers are given in term of as even or odd numbers then in that case change them into 2\*z for even and 2\*z + 1 for odd numbers.

In case combined rates are given, keep rates as 1/x and 1/y

> Use %ages rather than fractions to calculate the work done. For example, if a person can complete a work in 6 days, take its daily work rate as 16.6% rather tha 1/6.

> If (x men + y women) can complete a work in X days and (m men+n women) can complete a work in A days, then

xX + yX = mA + nA

> When a questions involves both men and women, convert man days to woman days and solve.

> If a machine can complete work in 'a' hours and another can in 'b' hours then stake of a is 1/a( 1/a + 1/b )

**Standard Deviation:**

\* Minimum number in a list of number with 2 standard deviations as -> s-2d, s-d, s, s+d, s+2d is "s-2d"

\* On multiplying list by a number X, standard deviation changes my multiple of X, if divided it dives else either it remains the same or pushed up

\* Decrease in values of a set by a givem amount will reduce the standard deviation

=========== Geometry ========

\* A right angle triangle has the maximum area when it is an isosceles triangle

\* Similar triangles has areas in the form that one area is some multiple of another area.

\* The area of a rhombus is not determined by squaring a side, but rather by taking half the product of the diagonals,

\* The number of diagonals in a figure - n\*(n-1)/3

\* median = sqrt(2\*b\*b + 2\*c\*c – a\*a)/4

Area of triangle = (Perimeter\*inscribed\_circle\_radius)/2

For a given perimeter, the equilateral triangle has the largest area and for a given area the equilateral triangle has the smallest perimeter.

**Equilateral triangle:**

**The radius of circumscribed triangle is: sqrt(3)\*a/3  
The radius of inscribed triangle is : sqrt(3)\*a/6**

**Altitude – sqrt(3)\*a/2**

**Circum radius = (2/3)\*a**

**in-radius = (1/3)\*a**

**So, the radius of in-circle is half of the radius of circumscribed circle.**

**Among all of the triangles possible for given dimension, the equilateral triangle encompass much area.**

**Isosceles Triangle:**

**For an isosceles triangle with the given length of equal sides, the right triangle has the largest area**

**For a given isosceles triangle : B^2/4 = L^2 – A^2**

**Where B is base, L is leg length (side which is equal to another one) and A is altitude**

**Radius of circle inscribed in right triangle = (a + b – c) /2**

**An altitude from right triangle to the other side creates 3 similar triangles. Also, that altitude = Hypotenuse/2**

**Sum of length of any 2 sides should be greater then 3rd side and difference between length of any 2 sides should < third side**

**Angle equation:**

**a/SinA = b/SinB = c/SinC**

**The cosine rule:**

**a^2 = b^2 + c^2 - 2 \*b\*c\*CosA Sinilar for other 2 combinations.**

**Congruent: Two triangles are said to be congruent when their sides and angles subtend.**

**Sample Conditions – SAS = ASA = SSS = AAS = SSA**

Polygon:

**In a polygon, sum of all external angles is 360 degrees.**

**Area of a polygon = ( (n\*s^2)/4 \* cot(180/n) )**

**Parallelogram:**

**Area of parallelogram = Base\*Height**

**Rhombus : A rhombus will equal diagonals is a square, also diagonal of rhombus intersect at 90 degrees**

**Area of rhombus = (diagonal\_1\*diagonal\_2)/2**

**Trapezoid : two paralle lines**

**Area = ½\*(b1+b2)\*height**

**Where median(average length of 2 bases) = (b1+b2)/2**

**Circle**

**To form a circle we should have 3 points which are not collinear**

**Length of chord = 2\*sqrt(r^r – d^d)**

**Where ‘r’ is the radius of circle and ‘d’ is the perpendicular distance from chord.**

======================= Coordinate Geometry ==============

We have the rectangle with dimensions 9\*6 (9 horizontal dots and 6 vertical). AB is parallel to y-axis and AC is parallel to x-axis.

Choose the (x,y) coordinates for vertex A: 9C1\*6C1;

Choose the x coordinate for vertex C (as y coordinate is fixed by A): 8C1, (9-1=8 as 1 horizontal dot is already occupied by A);

Choose the y coordinate for vertex B (as x coordinate is fixed by A): 5C1, (6-1=5 as 1 vertical dot is already occupied by A).

9C1\*6C\*8C1\*5C1=2160.

\* Perpendicular lines have -ve reciprocal slopes.If slope of line is m, then slope of line perpendicular to this line will be (-1/m)

\* The distance between two parallel lines = |b-c|(sqrt(m\*m + 1))

\* Distance between a point and a line = |ax0+by0+c|/sqrt(a\*a+b\*b) and when the point is origin the distance will be translated to |c|/sqrt(a\*a+b\*b)

-------------------------------------------------------------------------------------------

Short Solutions:

For any prime number n > 3 , whats the remainder if n^2 is divisible by 12.

Consider the product of elements (n-1) and (n+1)

both are before and after the prime number and have a difference of 2. So, (n-1) is divisible by 2 and (n+1) by 4. Since n is divisible by 12 one of the n-1, n+1 will be divisible by 3 because n is a prime number, so the number will be divisible by 24 (2\*4\*3)

or (n-1)\*(n+1) or (n^2 - 1) will be divisible by 24. So dividing n^2 will us the remainder 1.

There are 15 prime numbers between 1-50 and 25 prime numbers between 1-100

Do use P(~A) = 1 - P(A) at appropriate places

Probability:

Probability of occurring a certain event P k times in n-time sequence

P = nCk \* p^k \* (1-p)^(n-k)

Cues:

When checking for options, reduce the terms so that there is not odd one out.