## 1. Is it greater?

Let R(n,m) be a relation on two integers n and m. We know that R(n,m) is true if n>m. If we want to DISPROVE the claim, "R for all integers n and m", then we need to prove that:

Pick **ONE** option

- There exists a pair of integers n>m so that R(n,m) is false.
- There exists a pair of integers n<=m so that R(n,m) is false.
- There exists a pair of integers n>m so that R(n,m) is true.
- There exists a pair of integers n<=m so that R(n,m) is true.
- R(n,m) is false for every pair of integers n>m.
- R(n,m) is false for every pair of integers n<=m.

## 2. Miner in a Cave

Complete the blanks in the following question with the appropriate answer.

Miner is located in a cave. There are three passages starting from it:

- First leads to the exit from the cave and takes two hours;
- Second leads back to the starting point and takes five hours;
- Third leads back to the starting point too, but takes seven hours.

The cave is completely dark, so it is impossible to tell which passage the miner has already explored.

What is the expected time (in hours) needed to escape the cave?

The answer is: _____ hours. Please enter an integer

## 3. Four Robots

Four robots stand in the vertices of a unit square. At time zero, every robot starts to move with speed of one unit per second towards the clockwise neighbor, and continuously changes its' direction to face that neighbor. In what time will all robots meet?

Pick **ONE** option

- 1/2
- sqrt(2) / 2
- 1
- sqrt(2)
- 2
- Never

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## 4. Prime Numbers Program

Complete the blanks in the following question with the appropriate answer.

What is the value of the variable A after running the following program?

```
A = 0
B = 2
While (B < 30)
    If (B is a prime number)
        A = A + 81
    End
    B = B + 1
End
```

The value of A is _____

## 5. Two Vectors

You are given two n-dimensional vectors X and Y of length a1 and a2 respectively. Angle between them is 80 degrees. Denote by |v| the Euclidean norm of the vector v.
Which of the statements is sufficient to imply that |X - Y| < C?

Pick **ONE** option

- ○ C > max(a1 , a2) * 1.1
- ● C^2 >= a1^2+a2^2
- ○ C > 2 * (1/a1 + 1/a2)
- ○ C > a1 * a2
- ○ C > sqrt (a1 * a2)

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## 6. Median Distance

Complete the blanks in the following question with the appropriate answer.

Mark a point randomly inside a circle of radius 1 meter. Let D1 be the distance from the point to the center of the circle, and D2 be the distance from the point to the circumference.

Let D = min(D1,D2). Observe the distribution of D, what is the median value of D (in cm)?

The answer is _____ cm. Please enter an integer

Submit Answer & Continue

## 7. Guessing Game

Complete the blanks in the following question with the appropriate answer.

Alice and Bob are playing a guessing game. Than game is played in 10 rounds.
At each round, Alice draws a number from a truncated normal distribution with mu=30 & sigma=10 (values being capped between [0, 60]) and bob tries to guess the number Alice draws.

- If Bob's guess is right he receives 1000 dollars
- If Bob's guess is lesser than Alice's number, Bob loses 2 dollars
- If Bob's guess is higher than Alice's number, Bob loses 1 dollar

In a 10 rounds, what is the MAXIMUM EXPECTED money Bob can get?

Note:
Truncated Normal Distribution (bounded between a and b) is defined with following probability density function (PD

$$\psi(\mu,\sigma,a,b,x) = \begin{cases} 0, & \text{if } x < a \\ \frac{\phi(\mu,\sigma,x)}{\Omega(\mu,\sigma,b)-\Omega(\mu,\sigma,a)}, & \text{if } a \le x \le b \\ 0, & \text{if } x > b \end{cases}$$

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- If Bob's guess is lesser than Alice's number, Bob loses 2 dollars
- If Bob's guess is higher than Alice's number, Bob loses 1 dollar

In a 10 rounds, what is the MAXIMUM EXPECTED money Bob can get?

Note:
Truncated Normal Distribution (bounded between a and b) is defined with following probability density function (PDF)

$$\psi(\mu,\sigma,a,b,x) = \begin{cases} 0, & \text{if } x < a \\ \frac{\phi(\mu,\sigma,x)}{\Omega(\mu,\sigma,b)-\Omega(\mu,\sigma,a)}, & \text{if } a \le x \le b \\ 0, & \text{if } x > b \end{cases}$$

where $\phi(\mu,\sigma,x)$ is the probability density function for Normal distribution and $\Omega(\mu,\sigma,x)$ is the cumulative density function for the Normal distribution.

In this question $a = 0, b = 60, \mu = 30, \sigma = 10$

The answer is _____ dollars. Please enter an integer

Submit Answer & Continue

## 8. Maximal Variance

Complete the blanks in the following question with the appropriate answer.

What is the maximal possible variance of a random variable taking values in the interval [0, 10]?

The answer is: _____. Please enter an integer

Submit Answer & Continue

## 9. Biased Coin

Complete the blanks in the following question with the appropriate answer.

When flipped a biased coin has a probability of 0.99 for heads. You get $1 for heads and lose $100 for tails, what is your expected wealth after 3500 tosses?

The answer is $-35 _____. Please enter an integer

Submit Answer & Continue

## 10. Program

Complete the blanks in the following question with the appropriate answer.

Given the following program, what is the final value of C?

A is equal to 167

B is 91

C is 0

While A-2 is strictly greater than B

Subtract two from A

And add one to C

The answer is _____. Please enter an integer

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Submit Answer & Continue

## 11. Inequalities

Which of these inequalities is true?

Pick **ONE** option

- tan(pi) > sin(pi)
- sin(1 / 10000) > cos(1 / 10000)
- 3^(3^100000) > 4^(2^100000)
- log_(2^1000)(3^100) < log_(3^10000)(2^1000)
- None of the above

## 12. Two dice

Complete the blanks in the following question with the appropriate answer.

Player A rolls a fair die 2021 times. Player B rolls it 1010 times. For each player, the total number of odd numbers and even numbers that turned up as a result of each roll is tracked.
What is the probability that Player A got strictly more odd numbers than twice of Player B?

The answer is: _____. Please enter it as the decimal fraction using point to denote the decimal point (e.g., 0.123, 0.9 and so on)

Submit Answer & Continue

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## 13. Exponential Decay

For any integer k > 2, which equation below depicts exponential decay?

Pick **ONE** option

- ◯ y = ((2k + 1) / (2k + 2))^x
- ◯ y = (2k - 1)^x
- ◯ y = (2k + 1)^x
- ◯ y = ((2k - 1) / (2k - 2))^x

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## 14. My new car's future

Complete the blanks in the following question with the appropriate answer.

The Vehicle Regulating Committee made a decision today that the NOx emission limit will be halved every fourth year from now, starting with 0.08g/km. All cars having emission above the actual limit must be disassembled and recycled immediately. My new hybrid car has 0.0015g/km emission, which will grow as the car ages. The manufacturer says that the compound annual growth rate of the emission is 10%.

How many years will my car survive before disassemblement if the emission growth will be exactly as the manufacturer stated?

The answer is _____. Please enter an integer

Submit Answer & Continue

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## 15. Sum Calculation

Complete the blanks in the following question with the appropriate answer.

What is the value of the variable sum after the following pseudo-code runs?

```
sum = 0
for n in range 1 to 100 (inclusively):
  if n is odd:
    sum = sum + n
  else:
    sum = sum - 2
```

The answer is _____. Please enter an integer

WorldQuant Quantitative Researcher Math Test | Answered: **13 / 40** | **02 hours 20 mins** | Ruslan Mirmo

## 16. Quadrilateral

We cut zero-one interval into 4 parts by dealing the 3 separator points uniformly and independently from zero-one interval. What is the probability that the 4 segment can form a quadrilateral?

Pick **ONE** option

- 2/3
- 5/8
- 1/2
- 3/8

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Clear Selection

## 17. Sample Standard Deviation

Let S be a sample consisting of 300 real numbers. The sum of all numbers in S is 1500. The sum of squares of all numbers in S is 9000. What is the sample standard deviation for this sample?

Pick **ONE** option

- sqrt(3)
- 2
- sqrt(5)
- sqrt(6)

## 18. Fungi Population

The population of fungi changes every minute by 5% up or down with the same likelihood. The expected population size after 60 minutes is:

Pick **ONE** option

- Equal to the initial population size
- Cannot know from the given information
- Smaller then the initial population size
- Larger then the initial population size

Clear Selection

## 19. Asymptotic Complexities

Complete the blanks in the following question with the appropriate answer.

Below is a list of asymptotic complexities of eight functions, each with input of length N:

A. O(N^3)
B. O(Log(N))
C. O(Sqrt(N))
D. O(N * log(N))
E. O(2^N)
F. O(N^N)
G. O(N!)
H. O(Log(Log(N)))

Sort the functions by order of growth, with slower-growing functions first.

Your solution should be a sequence of letters corresponding to the functions above, eg "BACFDEHG".

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The answer is CDAEGF . Please enter without quotation marks

Submit Answer & Continue

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A. O(N^3)
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Sort the functions by order of growth, with slower-growing functions first.

Your solution should be a sequence of letters corresponding to the functions above, eg "BACFDEHG".

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The answer is CDAEGF . Please enter without quotation marks

Submit Answer & Continue

## 20. Red-Blue Line

Complete the blanks in the following question with the appropriate answer.

First half of a line of length 60 is painted by red. The other half is painted by blue. Two points are chosen, uniformly and independently distributed, on a line of length 60. What is average (expected) distance between them, given that both points are in the same half of the line (same color)?

The answer is: _____

Submit Answer & Continue

## 21. Tetrahedron

Complete the blanks in the following question with the appropriate answer.

Let A be a 15x20x30 rectangular parallelepiped . Let B be a tetrahedron on four non-adjacent vertices of A (i.e. no two vertices of B by an edge in A).

What is the volume of B?

The answer is: _____. Please enter an integer

Submit Answer & Continue

## 22. Linear Subspaces

Complete the blanks in the following question with the appropriate answer.

Suppose that there are three linear subspaces in a space V, each of them has dimension 5 and each of their pairwise intersection has dimension 3.
What is least number of dimension can V be?

The answer is: _____. Please enter an integer

Submit Answer & Continue

## 23. Perfect Squares

Complete the blanks in the following question with the appropriate answer.

How many integers n such that n!*(n+1)!*(n+2)!*(n+3)! is a perfect square are there in range [1, 1000] ? (The factorial of a positive integer n, denoted by n!, equals to 1*2*3*...*(n-1)*n. )

The answer is _____.

Submit Answer & Continue

## 24. Nice Places on Earth

We call a place on Earth "**nice**" if you go 1 mile North, 1 mile West, 1 mile South and 1 mile East then you end up at exactly the same place you started, but you did not visit any location more than twice. What is the minimum number of circumferences covering all **nice** places on Earth?

Pick **ONE** option

- 0
- 1
- 2
- 3
- Infinity

Solve question 25

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## 25. Repeated Application

Complete the blanks in the following question with the appropriate answer.

Given the following function definition:

```
define f(x):
    result = 1
    for i from 1 to x (inclusively):
        result = result + i
    return result
```

How many additions will take place while evaluating f(f(f(3)))?

The answer is: _____.



Submit Answer & Continue

## 26. Anti-Correlation

Assume there are three random variables X,Y,Z such that
corr(X,Y) = 0.5, corr(X,Z) = -0.5
What is the exact range for possible values of corr(Y,Z)?

Pick **ONE** option

- [-1, 0.8)
- (-1, 0]
- [-0.5, 0.5]
- [-1, 0.5]
- [illegible]
- [-1, sqrt(2)/2)

## 27. Polynomial

Complete the blanks in the following question with the appropriate answer.

Find a polynomial of degree 3 with leading coefficient 1 and roots equal to the squares of roots of the polynomial $z^3 - 2z - 5$.

In the answer give the sum of all coefficients of the polynomial, i.e. for $z^3 - 2z - 5$ this sum would be -6.

The answer is _____. Please enter the sum of coefficients. It is guaranteed to be an integer

Submit Answer & Continue

## 28. Volume

Complete the blanks in the following question with the appropriate answer.

Start with a cube (let us denote it by A). Put a point at the center of each of its faces and create a polyhedron (denoted by B) with these points as vertices. Put a point at the center of each of this polyhedron's faces and create a second polyhedron (denoted by C) with these new points as vertices.

What is the volume of the cube A if the polyhedron C has volume of 1?

The answer is _____. Please enter an integer

Submit Answer & Continue

## 29. Integral

Complete the blanks in the following question with the appropriate answer.

What is the value of the integral of the function f(x) = exp(-x/3) * cos(x), taken from zero to +infinity?

The answer is: _____.

Submit Answer & Continue

## 30. Estimate the Coin

You have a coin and your prior assumption is that its probability of heads P is chosen from a uniform distribution on [0,1]. You toss the coin 10 times and get 6 heads. What is your estimate of P?

Pick **ONE** option

- 7/12
- 6/11
- 7/11
- 6/10
- None of the above

Clear Selection

Saving...

## 31. The Liar Season

Complete the blanks in the following question with the appropriate answer.

In a town N, every person is either a truth-teller, who always tells truth, or a liar, who always lies. Every person in town N took part in a survey. "Is winter your favorite season?" was answered "yes" by 40% of respondents. Similar question about spring had 30% of affirmative answers, about summer - 50%, and about autumn - 0%.

What percent of town population actually has winter as a favorite season?

The answer is _____ %

Submit Answer & Continue

## 32. Walk on the Cube

Complete the blanks in the following question with the appropriate answer.

An ant walks along the edges of a cube, finding its way from a vertex O(0,0,0) ) to the opposite vertex S(1,1,1). The ant will give up if it happen to come back to the original starting point O. Also assume that when the ant reaches a vertex it chooses any of the three neighboring edges uniformly.

Suppose the ant succeeds to reach S, what is the expected length it walks?

The answer is: _____. Please enter an integer

Submit Answer & Continue

## 33. Random Game

Complete the blanks in the following question with the appropriate answer.

Each of four players writes their name on a card (all names are different). Each round these four cards are shuffled and randomly distributed among the players: one card to each player. If a player gets a card with their name, they get 1 point in th round. Otherwise, they get zero points. The game stops after 2021 round.

What is the the correlation between the numbers of points scored by two different players by the end of the game?

The answer is _____. Please enter and irreducible proper fraction, eg 1/2, 3/4. Please do not enter any spaces.

Submit Answer & Continue

## 34. Point in the Triangle

Complete the blanks in the following question with the appropriate answer.

Triangle ABC has sides of length AB = 45, AC = 60, and BC = 75. Place a point D randomly and uniformly inside the triangle. What is the probability that the largest perpendicular distance from point D to the triangle's three sides is the distance to side BC?

The answer is _____. Please enter a proper irreducible fraction. Please separate numerator and denomination by '/' and do not use any spaces. Examples: 1/2, 2/3, 23/97

Solve question 34 swer & Continue

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## 35. Powers of Two

Let x @ y = xy / (x+y). Which of the following numbers is the closest one to ((((((((1024 @ 512) @ 256) ... @ 4) @ 2 ?

Pick **ONE** option

- 1.1
- 1.01
- 1.001
- 1.0001

Solve question 35

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## 36. QuickSort

Complete the blanks in the following question with the appropriate answer.

Let N be the length of an array of real numbers. Select correct statements about quick sort algorithm. Your solution should be a sequence of letters in alphabetical order (e.g., ABCD).

- A. Guaranteed (worst-case) time complexity is O(N^2)
- B. Guaranteed (worst-case) time complexity is O(N * log(N))
- C. Guaranteed (worst-case) time complexity is O(N)
- D. Guaranteed (worst-case) time complexity is O(log(N))
- E. Expected (average) time complexity is O(N^2)
- F. Expected (average) time complexity is O(N * log(N))
- G. Expected (average) time complexity is O(N)
- H. Expected (average) time complexity is O(log(N))

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The answer is _____.

## 37. Inverse Matrix

Complete the blanks in the following question with the appropriate answer.

Given the following 3x3 matrix A:

1 2 2

2 2 1

1 2 1

What is the determinant of the inverse of A? (Please give the answer in decimal format, e.g. 1.1)

The answer is: _____.

Submit Answer & Continue

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WorldQuant Quantitative Researcher Math Test | Answered: **25 / 40** | **01 hour 18 mins** | Ruslan Mirmomino

## 38. Normal Distribution

Suppose Z is a standard normal variable and f(x) is the probability that Z>x (for x>0). Which of the following functions tends to zero as $x \to \infty$ at same rate as f (up to a constant multiple)?

Pick **ONE** option

- x^2 * exp(-x^2 /2)
- x * exp(-x^2 /2)
- exp(-x^2 /2)
- exp(-x^2 /2)/x
- [illegible] x^2
- None of the above

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Наиболее принятое геометрическое представление выпуклого многогранника — представление в канонической форме, когда все его рёбра доли

## 39. Three Dollars

Peter, Amy and John play the following game. Each starts with $1. A bell rings every 10 seconds, at which time each of the players who currently have money simultaneously chooses one of the other two players independently and at random and gives $1 to that player. Please note the player with $0 stays in the game.
What is the probability that after the bell has rung 2021 times, each player will have $1?

For example, Peter and Amy may each decide to give $1 to John, and John may decide to give his dollar to Amy, at which point Peter will have $0, John will have $2, and Amy will have $1, and that is the end of the first round of play. In the second round Peter has no money to give, but John and Amy might choose each other to give their $1 to, and the holdings will be the same at the end of the second round.

Pick **ONE** option

Solve question 37

- 1/7
- 1/4
- 1/3

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## 40. Knapsack Problem

Complete the blanks in the following question with the appropriate answer.

You are given a list of items each having weight w_i and price p_i. You are to select the subset of items with total weight not exceeding W and with maximal possible total price (each item can be used at most once).

For a given table of w_i and p_i, what is the maximal possible total price for W=18?

| Item number | w_i | p_i |
|---|---|---|
| 1 | 3 | 10 |
| 2 | 4 | 12 |
| 3 | 5 | 18 |
| 4 | 6 | 19 |
| 5 | 7 | 20 |
| 6 | 8 | 19 |
| 7 | 5 | 12 |