



LS & JB 22.1.2022

Lumina is a new mining token on the Polygon ([MATIC](#)) network that is optimized to make cryptomining easy and profitable for every cryptominer. Lumina's ultimate goal is to create a cryptocurrency that is an effective store of value by introducing a more efficient and democratic crypto mining process.

Lumina's features have been carefully designed with the following results in mind:

- Fun to own
- Easy and exciting to mine
- Limited in supply
- Beneficial to save and accumulate
- Distributed fairly and balanced
- Consume low energy
- Protected against rug pull
- Inspiring further innovation

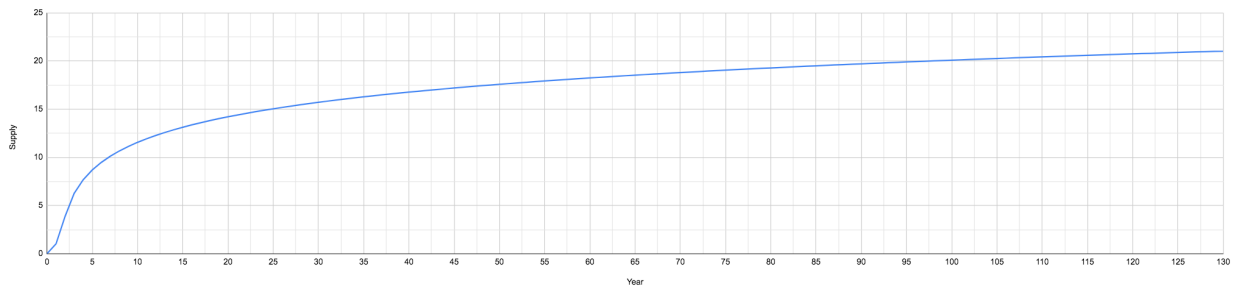
## Introduction

Lumina's smart contract presents miners with a list of challenges of various difficulties that they can try to solve using the mining page, GoMiner software, or their own mining technology to find the solutions as quickly as possible. Up to 100 regular and up to 100 premium challenges can be presented at the same time. Each challenge can be solved and claimed by multiple miners up until all tokens allocated for each challenge are claimed. When all allocated tokens are awarded, the challenge will expire and a new challenge with highest difficulty will be added to the bottom of the list and the difficulty of all previous challenges will be lowered by 2 difficulty points. As a result, it is guaranteed that all challenges will eventually be solved by miners in a reasonable amount of time while consuming a reasonable amount of energy.

The total supply of the Lumina tokens is 21,000,000. 96.2% of these tokens are available to be mined by miners. The remaining 3.8% of mined tokens are allocated to developers and marketers and released to them proportionally to the amount of Lumina mined.

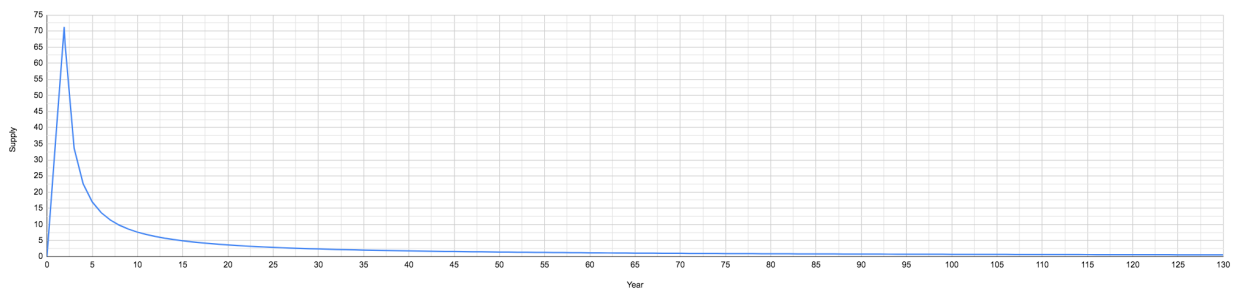
The mining era is expected to be around 137 years.

Lumina Supply over Time in Millions (Mining stops at 21M)



The mining era consists of a short Newton epoch and a long Einstein epoch.

Weekly Supply of Lumina in Thousands



During the Newton epoch, challenges are issued every 100 blocks or approximately once per 224 seconds (3.5 minutes). The purpose of this epoch is to slowly grow the supply of tokens and distribute them among as many miners as possible in order to minimize the emergence of large token holders (whales) which could manipulate the token price. In the Newton epoch, it is expected that 3.6 million Lumina will be mined in around 2 years.

During the Einstein epoch, the interval between challenges will gradually increase by 2 blocks approximately every week. This time dilution will result in increasingly fewer tokens mined per week. This will make Lumina harder to obtain over time.

## Challenges

During the Newton epoch, the smart contract will create a new challenge on average every 100 Polygon blocks. We assume each Polygon block takes approximately 2.1 seconds, thus a new challenge can be added approximately every 3.5 minutes.

The challenges are hashes of the most recent blocks deterministically selected by the smart contract at the time of the challenge creation. The goal of the miners is to combine this hash with the unique address of their wallet and find a nonce that will produce Keccak-256 hash within a certain range defined by the difficulty level. By

combining the block-hash with individual wallet addresses, the miners are looking for unique solutions specific for their wallets. That way it is not possible to use one solution to claim multiple rewards. Challenges with special block-hashes having one or more 2s as the leading digits are classified as premium challenges. These have higher rewards and can be claimed by a greater number of miners. Below is a summary of all types of challenges and their properties during the Newton epoch:

Level	Challenge Type	BlockHash Criteria	Claims per Challenge	Tokens per Claim Weekly Increase		Average Time Frequency	Challenges per Week	Average Tokens per Week	
				From	To			From	To
0	Regular	Does not start with 0x2	10	0.01	1	3.7 min	2,700	270	27,000
1	Premium	Starts with 0x2	20	0.05	5	1 hour	168.75	169	16,875
2	Premium	Starts with 0x22	50	0.2	20	16 hours	10.5	105	10,547
3	Premium	Starts with 0x222	100	1	100	11 days	0.66	66	6,592
4	Premium	Starts with 0x2222	200	5	500	6 months	0.041	41	4,120
5	Premium	Starts with 0x22222	500	20	2000	7 years	0.0027	27	2,747
<b>TOTAL</b>							<b>2,880.00</b>	<b>679</b>	<b>67,880</b>

During the Newton epoch, the rewards for regular challenges grow from 0.01 token by 0.01 token each week until 1 token per challenge is reached.

On the end of the Newton epoch the rewards per challenge stabilize as follows:

Level	Challenge Type	BlockHash Criteria	Claims per Challenge	Tokens per Claim	Tokens per Challenge	Average Time Frequency	Challenges per Week	Average Tokens per Week
0	Regular	Does not start with 0x2	10	1	10	3.7 min	2,700	27,000
1	Premium	Starts with 0x2	20	5	100	1 hour	168.75	16,875
2	Premium	Starts with 0x22	50	20	1,000	16 hours	10.5	10,547
3	Premium	Starts with 0x222	100	100	10,000	11 days	0.66	6,592
4	Premium	Starts with 0x2222	200	500	100,000	6 months	0.041	4,120
5	Premium	Starts with 0x22222	500	2000	1,000,000	7 years	0.0027	2,747
<b>TOTAL</b>							<b>2,880.00</b>	<b>67,880</b>

Once 1 Lumina token per regular challenge is reached, the Einstein epoch starts.

The token rewards per challenge during the Einstein epoch will be kept stable. However during this epoch the smart contract will increase the interval between challenges by two Polygon blocks approximately once per week. Because fewer challenges will be

issued per week, there will also be fewer tokens mined per week over time. As example a mining situation after five years is expected to be as follows:

Level	Challenge Type	BlockHash Criteria	Claims per Challenge	Tokens per Claim	Tokens per Challenge	Average Time Frequency	Challenges per Week	Average Tokens per Week	Time Lapsed
0	Regular	Does not start with 0x2	10	1	10	23 mins	435	4,355	5 years
1	Premium	Starts with 0x2	20	5	100	6 hours	27.22	2,722	
2	Premium	Starts with 0x22	50	20	1,000	4 days	1.70	1,701	
3	Premium	Starts with 0x222	100	100	10,000	2 months	0.11	1,063	
4	Premium	Starts with 0x2222	200	500	100,000	3 years	0.007	664	
5	Premium	Starts with 0x22222	500	2000	1,000,000	43 years	0.0004	443	
TOTAL							464.52	10,948	

## Solved Difficulty Level

The smart contract verifies if the miner solved the required difficulty level as below. The keccak256 hash is calculated on a blob produced by combining bits of the block number, block hash, and wallet address, concatenated with the solution found by the miner. If the N leading bits in the resulting hash are all 0, then the smart contract will acknowledge that the miner's solution solves the required difficulty level of N.

```
function verifySolution(uint64 blockNumber, uint256 solution) public view
whenNotPaused returns (uint16 solvedDifficulty) {
    (Challenge memory ch, bool premium, uint8 generalDifficulty) =
    _retrieveChallenge(blockNumber);

    bytes32 digest = keccak256(abi.encodePacked(uint256(ch.blockNumber) ^
uint256(ch.blockHash) ^ uint256(msg.sender), solution));

    solvedDifficulty = 256 - _findHsb(uint256(digest));
}
```

## Difficulty Levels

Difficulty Level is expressed as a simple integer between 20 and 218. Difficulty level 20 is the easiest and the difficulty level 218 is the hardest. On average the number of hashes required to solve a challenge is 2 raised to the power of the difficulty level. The table below shows the average time needed to solve a challenge of a particular difficulty level using a web browser (hash rate 10K hashes / second), GO Miner tool on PC (5

mega hashes / second), and on custom mining solution using a GPU or FPGA (5 giga hashes / second)

Difficulty Level	Hash Count 2^Level	Web Browser	GO Miner	Custom/GPU
20	1,048,576	1.75 min	0.21 s	0 s
22	4,194,304	6.99 min	0.84 s	0 s
24	16,777,216	27.96 min	3.36 s	0 s
26	67,108,864	1.86 hr	13.42 s	0.01 s
28	268,435,456	7.46 hr	53.69 s	0.05 s
30	1,073,741,824	1.24 days	3.58 min	0.21 s
32	4,294,967,296	4.97 days	14.32 min	0.86 s
34	17,179,869,184	19.88 days	57.27 min	3.44 s
36	68,719,476,736	79.54 days	3.82 hr	13.74 s
38	274,877,906,944	318.15 days	15.27 hr	54.98 s
40	1,099,511,627,776	3.48 years	2.55 days	3.67 min
42	4,398,046,511,104	14 years	10.18 days	14.66 min
44	17,592,186,044,416	56 years	40.72 days	58.64 min
46	70,368,744,177,664	223 years	162.89 days	3.91 hr
48	281,474,976,710,656	892 years	1.78 years	15.64 hr
50	1.1259E+15	3,568 years	7.1 years	2.61 days
52	4.5036E+15	14,271 years	29 years	10.42 days
54	1.80144E+16	57,084 years	114 years	41.7 days
56	7.20576E+16	228,337 years	457 years	166.8 days
58	2.8823E+17	913,347 years	1,827 years	1.83 years
60	1.15292E+18	3,653,388 years	7,307 years	7.31 years
62	4.61169E+18	14,613,551 years	29,227 years	29 years
64	1.84467E+19	58,454,205 years	116,908 years	117 years
66	7.3787E+19	233,816,818 years	467,634 years	468 years
68	2.95148E+20	935,267,274 years	1,870,535 years	1,871 years
70	1.18059E+21	3,741,069,095 years	7,482,138 years	7,482 years
72	4.72237E+21	14,964,276,380 years	29,928,553 years	29,929 years
74	1.88895E+22	59,857,105,520 years	119,714,211 years	119,714 years
76	7.55579E+22	239,428,422,079 years	478,856,844 years	478,857 years
78	3.02231E+23	957,713,688,315 years	1,915,427,377 years	1,915,427 years
80	1.20893E+24	3.83E+12 years	7,661,709,507 years	7,661,710 years
82	4.8357E+24	1.53E+13 years	30,646,838,026 years	30,646,838 years
84	1.93428E+25	6.13E+13 years	122,587,352,104 years	122,587,352 years
86	7.73713E+25	2.45E+14 years	4.90E+11 years	490,349,408 years
88	3.09485E+26	9.81E+14 years	1.96E+12 years	1,961,397,634 years

90	1.23794E+27	3.92E+15 years	7.85E+12 years	7,845,590,535 years
92	4.95176E+27	1.57E+16 years	3.14E+13 years	31,382,362,139 years
94	1.9807E+28	6.28E+16 years	1.26E+14 years	125,529,448,555 years
96	7.92282E+28	2.51E+17 years	5.02E+14 years	502,117,794,219 years
98	3.16913E+29	1.00E+18 years	2.01E+15 years	2.01E+12 years
100	1.26765E+30	4.02E+18 years	8.03E+15 years	8.03E+12 years
102	5.0706E+30	1.61E+19 years	3.21E+16 years	3.21E+13 years
104	2.02824E+31	6.43E+19 years	1.29E+17 years	1.29E+14 years
106	8.11296E+31	2.57E+20 years	5.14E+17 years	5.14E+14 years
108	3.24519E+32	1.03E+21 years	2.06E+18 years	2.06E+15 years
110	1.29807E+33	4.11E+21 years	8.23E+18 years	8.23E+15 years

As can be seen, it is practically impossible to solve challenges with higher difficulty level numbers using current technologies. For example, a custom solution with 5G/s hash rate would need 8 billion years to solve the difficulty level 100. That is longer than the lifetime of the sun.

## Difficulty Level Discounts

In order to make the mining process fair and balanced, the smart contract will grant discounted difficulty levels to specific miners using predefined rules based on their wallet address and their registered balance.

## Registered Balance

In order to incentivize saving and accumulation of Lumina tokens, the smart contract will grant discounts to miners based on their Lumina token balance. In order to maintain fairness, it is not desirable to apply the balance at the time of claiming the reward, because miners could easily borrow or move tokens to their wallets right before claiming. It is fair to apply the balance that is maintained in the wallet during the entire time that a challenge is mined. However from a technical perspective it would not be practical to keep the full history of wallet balances in the blockchain. Therefore, Lumina implements a concept of "registered balance" which will be managed by the smart contract as follows:

- At the smart contract creation, the registered balance of any wallet is 0.
- When a wallet receives and mines any Lumina Tokens, the owner can register their non-zero balance with the smart contract from the mining web page.

- The registered balance will be applicable to future challenges created after registration.
- The smart contract will maintain the history of the last three registered balances.
- The registered balance will be automatically adjusted downwards by the smart contract, if any transfer decreases the wallet's balance below the latest registered balance.
- When a token transfer increases the current balance, the smart contract will NOT adjust the latest registered balance.

Based on the rules above the miners might consider registering their balance in the following cases:

- after increasing a balance in their wallet to make the smart contract apply the higher registered balance
- before selling or transferring out the tokens from the wallet, to protect the latest registered amount

## Wallet Discount

The address discount is determined based on the similarity between the wallet address and the challenge's block-hash. The contract will compare the lowest significant bits of the block-hash with the least significant bits of the wallet's address. The formula is defined as follows:

```
n = lsb(blockHash ^ address)
if(balance >= 1.0) {
    if(n >= 20) {
        n = 30
    } else if(n >= 10) {
        n = 20 + (n - 10)
    } else {
        n = 2 * n
    }
} else {
    if(n > 10) {
        n = 10
    }
}
```

Thus, the wallet difficulty level discount is determined as follows:

Matching bits	Wallet discount	
N	$0 \leq RB < 1$	$1 \leq RB$
0	0	0
1	1	2
2	2	4
3	3	6
4	4	8
5	5	10
6	6	12
7	7	14
8	8	16
9	9	18
10	10	20
11	10	21
12	10	22
13	10	23
14	10	24
15	10	25
16	10	26
17	10	27
18	10	28
19	10	29
20+	10	30

- N - number of matching lowest significant bits between the wallet address and the block-hash
- RB - registered balance, number of Lumina tokens in the wallet

The maximum wallet discount possible is 30. The wallet discount is capped at 10 for wallets with very low or zero balance, to limit the ability of miners to generate a large number of wallets for the sole purpose of matching the challenges.



## Balance Discount

The wallet discount can further be augmented by a balance discount granted by the smart contract to miners who registered their Lumina token balances. The balance discount is granted as follows:

Registered Balance	Balance Discount
0	0
0.001	1
0.002	2
0.005	3
0.01	4
0.02	5
0.05	6
0.1	7
0.2	8
0.5	9
1	10
2	12
3	14
5	16
10	18
20	20
50	22
100	24
200	26
500	28
1000	30

The maximum balance discount is 30 at the registered balance of 1000 tokens. The maximum combined wallet and balance discount is 60, which is great enough to give any individual a chance to compete with the most advanced pools of mining resources.

## Collaborative Mining

The wallet owners with addresses holding balances 0.01 Lumina tokens or more can issue commissions up to 90% to other miners for solving challenges on their behalf. The default commission is 22%.

## Developer Tokens

All 21 million Lumina tokens are pre mined and hidden in the ground to be mined by miners. 4.75% of the tokens are locked in Developer's Contracts and released to developers and marketers proportionally to the number of Lumina mined. This way developers cannot pull the rug underneath miners and holders by destroying the Lumina price.

## Liquidity Pool

The developers and marketers have deposited 1000 Lumina and 500 Polygon MATIC tokens to the initial liquidity pool on QuickSwap and given up their rights to withdraw their deposits.

## Lumina Token Mining Page

The Lumina token mining page provides all information and functionality to begin mining the Lumina tokens.

## Tutorial for Beginners

Even total beginners can start earning Lumina tokens on Polygon without any mining experience or having to deposit any money.

- Install [Metamask](#) in your browser
- Connect Metamask to [Polygon](#) network
- Add minimum funds to your wallet through Matic Faucet, so you could make transactions
- Go to Lumina token mining page to start mining