

## Blockchain and Cryptocurrencies Coursework

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## 1 Mining Puzzles

## 1.1 Proof of Work

The requested information for Proof of Work is as follows:

Index	Information	Value
1	User ID	pbqk24
2	Block hash target calculated (hex)	000003e7fc1800000000000000000000 00000000000000000000000000000000
3	Nonce value (int)	2171906
4	Number of (double) hashes performed	2171907 (one per nonce tried, starting at 0)
5	Estimate for mining time for difficulty = 1 Estimate for mining time for difficulty = 7454968648263	58629 seconds $4.37 \times 10^{17}$ seconds

**Table 1:** Mining Puzzles: Information Requested

The equations used for calculating the mining time estimates  $t$  are as follows:

$$target = \frac{target_{initial}}{difficulty} \quad (1)$$

$$h_q = \frac{h_{space}}{target} \quad (2)$$

$$t = h_g * t_h \quad (3)$$

Where  $h_q$  is the estimated number of hashes required to be performed to find a valid hash, *target* is the target value,  $t_h$  is the estimated time per hash calculated by timing how long it takes to perform a large number of hashes (e.g.  $10^9$ ) and finding the average.  $t_h$  was computed as  $1.365 * 10^{-5}$  and used for both calculations.

For difficulty of 1:

$$target = \frac{00000000FFF00}{1}$$

[illegible]

$$t = 4295032833 * 1.365 * 10^{-5} = 58629$$

For difficulty of 7454968648263:

[illegible]

$$h_q = \frac{2^{256}}{3.62 * 10^{54}} = 3.2 * 10^{22}$$

$$t = 3.2 * 10^{22} * 1.365 * 10^{-5} = 4.37 * 10^{17}$$

## 1.2 Proof of Stake

The requested information for Proof of Stake is as follows:

Index	Information	Value
6	ECDSA public key (hex)	4f045a6cfacb3e67e7c5d4ddfb9f1acfe7d6ddda c29869734cce5218cdab24e2d2cc72601138d6f 324464df7691f819cd14e8b3752d9c463e5162a ad37393ca0
7	Signature of "Hello world" (hex)	eae12ab8fdbeb5635ac45edbfceb999907a5b090 42eeddbd9a07a744f656b3ac7e00124086256e5 caf86539e68186742d593e5e8b537b9f6d7ee055 57c2ef68a
8	Signature used to calculate hit (hex)	aa2974089248c51977f63350c3aad2757b935d68 a236dd777621c3ed879657d2c5e1f01d22ad16b b2d37f1c2567d1daeccd4e3f1a45201f53291e2e ba9e9bea3
9	Hit value (hex)	a135a0781dd3c0f6
10	Time (s) that you could forge a new block	394

**Table 2:** Mining Puzzles: Information Requested

The equations used for calculating the hit value are as follows:

$$hit_{full} = hash(sign(S_g)) \quad (4)$$

Where the hit value is the first 8 bytes of  $hit_{full}$ , and  $S_g$  is the generation signature for the previous block:

$$S_g = 9737957703d4eb54efdf91e15343266123c5f15aaf033292c9903015af817f1$$

$$sign(S_g) = aa2974089248c51977f63350c3aad2757b935d68a236dd777621c3ed879657d2c5e1f01d22ad16bb2d37f1c2$$

$$hash(sign(S_g))[:8] = a135a0781dd3c0f6$$

The time in seconds when you would be able to forge a new block was calculated using the following equations:

$$T = T_b * B_e \quad (5)$$

$$t_{forge} = \frac{hit}{T} \quad (6)$$

Where  $T$  is the target value (independent of time passed),  $T_b$  is the base target value,  $B_e$  is your effective balance, and  $t_{forge}$  is the time when you can forge a new block (rounded up, in seconds):

$$T = 1229782938247303 * 24 = 29514790517935272$$

$$t_{forge} = \frac{11616367251628998902}{29514790517935272} = 394$$