

## detail breaking a 16 char a-zA-Z0-9 password

< Breaking a 16 character password that contains a mix of upper and lower case letters, as well as numbers (a-zA-Z0-9), is a difficult task that can take a significant amount of time and computing power, depending on the strength of the password and the methods used to break it.

One common method used to break passwords is brute force, which involves trying every possible combination of characters until the correct password is found. The number of possible combinations for a 16 character password that contains a-zA-Z0-9 is extremely high, with a total of  $62^{16}$  or approximately  $4.67 \times 10^{28}$  possible combinations. Even with the use of high-performance computing, this process could take years or even centuries to complete.

Another method is to use a dictionary attack, which involves trying a list of known words and phrases as the password. However, if the password is not based on any commonly used words or phrases, this method is unlikely to be successful.

A third method is to use a hybrid approach, which combines elements of both brute force and dictionary attacks. For example, an attacker might try every possible combination of characters up to a certain length, and then switch to using a dictionary attack if the password has not been found by that point.

However, if the password has been well-designed and is a truly random combination of characters, breaking it through any of these methods is unlikely to be successful within a reasonable amount of time. The best way to protect against password cracking is to use a strong, unique password that is not based on any easily guessable information such as your name, birthdate, or common words. Additionally, using two-factor authentication or a password manager can add an extra layer of security to your accounts.

## no way to break a password like CeNxuk4z16Ak2MJZ with dictionaries, even hybrid? break down the math

< It is unlikely that a password like “CeNxuk4z16Ak2MJZ” could be cracked using a dictionary attack or even a hybrid approach, as this password appears to be a completely random combination of upper and lowercase letters and numbers, without any recognizable words or phrases.

The password has a length of 16 characters and includes a total of 62 different characters (26 uppercase letters, 26 lowercase letters, and 10 digits). The total number of possible combinations of 16 characters using these 62 characters is  $62^{16}$ , which is approximately  $4.67 \times 10^{28}$ .

Even if an attacker were to use a hybrid approach, trying every possible combination of characters up to a certain length and then switching to a dictionary attack, it is unlikely that a dictionary would contain a word or phrase that matches this password.

Assuming an attacker is able to try 1 billion ( $1 \times 10^9$ ) password guesses per second, which is a fairly optimistic estimate, it would still take approximately  $1.48 \times 10^{16}$  years to try all possible combinations of this password. This is significantly longer than the age of the universe, which is estimated to be approximately 13.8 billion years.

It's worth noting that the actual time required to crack a password can vary depending on a number of factors, including the strength of the password and the methods used by the attacker. However, it is safe to say that a strong, random password like “CeNxuk4z16Ak2MJZ” is very difficult to crack and provides a high level of security for your accounts.