
DOOR CODES AND CRYPTOGRAPHY

WORKED SOLUTION

Question 1

Total possible combinations = possible numbers per digit^{number of digits}

$$\text{Total possible combinations} = 12^7$$

$$\text{Total possible combinations} = 3.58 \times 10^7 \text{ (1 mark)}$$

To work out the maximum time to crack the code trying 1000 possibilities a second:

$$\text{Max time to crack} = \frac{\text{total number combinations}}{\text{tries per second}}$$

$$\text{Max time to crack} = \frac{3.58 \times 10^7}{1000}$$

$$\text{Max time to crack} = 3.58 \times 10^4 \text{ seconds} = \mathbf{9.94 \text{ hours (1 mark)}}$$

Question 2

The total number of possible combinations is:

Total possible combinations = possible numbers per digit^{number of digits}

$$\text{Total possible combinations} = 10^4$$

$$\text{Total possible combinations} = 10000$$

At one code per second, we can calculate how many codes you can test in 1 hour and 5 minutes:

$$\text{Number of codes testable} = \text{time left} \times \text{tests/second}$$

$$\text{Number of codes testable} = 3900 \text{ s} \times 1 \text{ code/s}$$

$$\text{Number of codes testable} = \mathbf{3900 \text{ codes (1 mark)}}$$

3900 is 39% of the 10000 possible codes. So if this scenario was run over and over again, in 39% of scenarios you would find the correct code before the timer runs out. **(1 mark)**

Question 3

The question asks for the maximum time possible, which means that we can assume you have to try all 10000 possible codes before you crack it. 10000 codes will result in 10000 / 5 = 2000 lots of 30 second time outs.

$$\text{Maximum time to crack with timeouts} = \text{code entering time} + \text{timeout time}$$

$$\text{Maximum time to crack with timeouts} = 10000 \times 1\text{s} + 2000 \times 30\text{s}$$

Maximum time to crack with timeouts = 70000 s

Maximum time to crack with timeouts = 19.44 hours (1 mark)

Comment: The time out makes a very large difference to the maximum time – without the timeout the maximum time is just 10000s or about 2.8 hours, but with the timeout this maximum time blows out to 19.4 hours. **(1 mark)**

Question 4

We need a code made up of the 95 ASCII printable characters that has at least the 3.58×10^7 possible code combinations for the security system in Question 1:

$$95^{\text{required number of digits}} = 3.58 \times 10^7 \text{ (1 mark)}$$

We can use logarithms to work this out directly:

$$\log(95^{\text{required number of digits}}) = \log(3.58 \times 10^7)$$

$$\text{Required number of digits} \times \log(95) = \log(3.58 \times 10^7)$$

$$\text{Required number of digits} = 3.82 \text{ digits}$$

As the code must be *at least* as secure, we need to round up the digits to 4 **(1 mark)**.

With more character options, you can maintain security with fewer digits, at least from brute force attacks. This is why many online passwords required you to use a mix of lowercase and uppercase letters, numbers and symbols when creating passwords.

