

# Questions for ChatGPT on calculating humidity

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The following exercise is intended for use in technical degree programmes. The exercise is suitable for use in a course as well as for reflection at home. A basic knowledge of the subject matter is required.

The aim is to show the limits and possibilities of programmes such as ChatGPT when dealing with technical issues. The task for the learners is to understand the answer and explain why ChatGPT provides a correct answer.

In the example, the user asks ChatGPT a question about calculating humidity without providing any further context. The answer does not require any transfers or interpretations that require background understanding.

The exercise illustrates that ChatGPT will produce a correct result for calculations if the task is clearly formulated and the necessary calculation variables are included in the question. However, ChatGPT is a programme that is primarily designed for text production. It cannot form chains of reasoning that are limited exactly to the formulated question and often provides unnecessary and undocumented additional information for answers.

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## Questions for ChatGPT on calculating humidity<sup>1</sup>

### user

How can I find out how much water is in a room with a volume of 20 cubic metres at 50% relative humidity?

### ChatGPT

In order to determine how much water is contained in a room with a volume of 20 cubic metres at 50% relative humidity, we need to know the water vapour content of the air. This depends on the temperature, as warm air can hold more moisture than cold air.

### Here is a step-by-step guide to calculate this:

1. Saturation vapour pressure ( $e_s$ ): Determine the saturation vapour pressure for the given temperature. This can be derived from tables or formulas for the saturation vapour pressure of water.

2. Actual vapour pressure ( $e_a$ ): The actual vapour pressure can then be calculated by the relative humidity:

$$e_a = \frac{RH}{100} \cdot e_s$$

where RH is the relative humidity in per cent.

3. Specific humidity ( $q$ ): Specific humidity is the ratio of the mass of water vapour to the mass of humid air. This can be calculated using the formula

$$q = \frac{0,622 \cdot e_a}{p - e_a}$$

where  $p$  is the total pressure of the air (usually about 1013 hPa).

4. Mass of the water vapour ( $m_w$ ): Finally, the mass of water vapour in the air can be calculated:

$$m_w = q \cdot \rho_{air} \cdot V$$

where  $\rho_{air}$  is the density of the air (about 1.2 kg/m<sup>3</sup> at standard conditions) and  $V$  is the volume of the room.

<sup>1</sup> The conversation took place on 12 September 2024 with the free version of <https://openai.com/chatgpt>

We need a temperature for the calculation, as the saturation vapour pressure is temperature-dependent. Let us assume that the temperature in the room is 20°C. The saturation vapour pressure at 20°C is about 23.37 hPa.

**Example calculation:**

1. Saturation vapour pressure at 20°C:  $e_s = 23.37$  hPa.

2. Actual vapour pressure at 50% relative humidity:

$$e_a = \frac{50}{100} \cdot 23,67 = 11,685$$

3. Specific humidity:

$$q = \frac{0,622 \cdot e_a}{p - e_a} = \frac{0,622 \cdot 11,685}{1013 - 11,685} \approx 0,0072$$

4. Water vapour mass:

$$m_w = q \cdot \rho_{air} \cdot V = 0,0072 \cdot 1,2 \frac{kg}{m^3} \cdot 20 m^3 \approx 0,173 kg$$

The total amount of water in the room is therefore approximately 0.173 kg or 173 g.

**Note:**

The example is correctly derived. Although ChatGPT primarily produces texts, the result is correct.