Writing Guide Report Experiment 2

How to write a report

Abstract

This document provides useful information, tips and examples to support you while writing your report. It highlights key moments you may encounter during the process and offers guidance to help you structure and improve the overall quality of your work.

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Content

Introduction

This report must describe your work on *Experiment 2: Modelling of* a Single-Volume Water Tank in a clear, complete, and structured way. The aim is to show that you fully understand what you are doing and can present your results in an organized and readable manner. Next to this, it is important that you can properly explain the meaning of those results. The report must be written so that someone who has never seen the experiment file could reproduce the entire test procedure using only your report.

For this report, we expect you to use full sentences and write in a narrative style. Meaning that the conclusion shouldn't be built up from bullet points, but it should be a coherent and flowing story. The only part where multiple following bullet points should or can be used is in the Methods section. Also, it is expected that all diagrams, figures, and tables must be clearly numbered, for example, *Figure 1*, *Figure 2*, or *Table 1*, and they must be referred to in your text. The structure of the report must be the same as the order of the topics mentioned.

1. Title Page

The title page should be simple and professional. It ***must*** contain:

- *Experiment 2: Modelling of Single-Volume Water Tank*
- Student name and student ID
- Course name and code
- Instructor's name
- Date of experiment and date of submission

No extra decoration or content is required.

2. Abstract

The abstract is a compact summary of the entire report. Although located first in the report, it should be the ***last section you write***. It must be one paragraph of around 150–200 words.

It must include the following three elements:

Aim:
State that the experiment aims to determine. Or what is expected to be learned from the experiment.

Method:
Explain briefly what handlings were performed to get the results and how the results were recorded. (for example, changing the variable P)

Conclusion:
Report the averaged values of the gain, time constant, and delay time for each controller tested.

Briefly describe how the system behaved, whether this matched what you expected, and whether the experiment effectively demonstrated the concepts it aimed to teach.

Example of an abstract:
This report investigates how the temperature of a cup of tea changes over time after it is made. The experiment involves preparing a standard cup of tea and recording its temperature at regular intervals as it cools. The aim is to observe the cooling pattern and identify factors that may influence heat loss, such as the material of the cup or whether the tea is stirred. Data is presented in tables and graphs to illustrate the rate of temperature change. The results show that the tea cools rapidly during the first few minutes before gradually leveling off, demonstrating a typical cooling curve. Overall, the system behaved as expected, following the expected pattern of heat loss to the surrounding air.

3. Introduction

The introduction must be written in your own words. It explains **what** the experiment is about and **why** it is performed and **not how** . Do not describe the method here; that belongs in the later section.

Begin by describing the ***background*** of the experiment. The background information in an experimental report explains the scientific context and theory behind the experiment. It includes key concepts, principles, laws, and definitions that help the reader understand how and why the experiment is done.

After this you should write the **aim** of your experiment. Clearly state what you want to find out with the experiment. This should be a short statement.

Than write a **brief description** of what you did in the experiment. It tells the reader how the goal of your experiment will be achieved, but does not include step-by-step procedure or detailed methods. This will give the reader a better idea of what you did in the experiment.

Finaly describe the **significance** of the experiment. Explain why the experiment is important and what it helps you to understand.

4. Experimental Setup and Procedure

This combined section must allow someone unfamiliar with the experiment to **fully reproduce it**. The first part is written as continuous prose explaining the system, followed by the detailed step-by-step procedure.

4.1 System Description

The *System Description* section explains **what tools, materials, or equipment** were used in your experiment or project, and **how these parts work together** as a system.
It focuses on **what the system is and what it does**, not yet on **what you did with it** (that belongs in the *Approach* section).

Think of it as describing the **setup** or **design** of the system, the components, their functions, and how they connect or interact.

A *System Description* should give the reader a **clear picture of your setup** without requiring photos or diagrams *(though those can be added as support)*.
Your goal is that someone could recreate your setup just by reading your description.

Tips

- Use **third person** and **past or present tense** (depending on whether the system still exists).
- Mention **each key component** and **its function**.
- Explain briefly **how the parts interact** or how data is collected.
- Avoid unnecessary detail about *steps* (that's for the Approach section).
- Write in **complete sentences**, possibly organised in short paragraphs or numbered points.

Example of transformation:

Too short / bullet-style:

- Kettle used to heat water
- Thermometer used to measure temperature
- Ceramic cup used for tea
- Timer to measure cooling period

Better – written as connected text:
The system used for this experiment was designed to prepare a cup of tea and monitor its cooling process over time. It included four main components: a kettle, a ceramic cup, a digital thermometer, and a timer.
The **kettle** was responsible for heating the water to approximately 100°C. The **ceramic cup** served as the container for the tea, chosen for its ability to retain heat and provide consistent results. The **digital thermometer** was used to measure the temperature of the tea at specific intervals, ensuring precise and reliable readings. Finally, the **timer** was used to track the time between measurements, allowing consistent data collection every five minutes.
Together, these components created a simple yet effective system to observe how the temperature of a freshly made cup of tea decreases over time.

Writing Checkpoints

Before you move on, ask yourself:

- Have I described *all* components of my setup?
- Did I explain *what each part does*?
- Can a reader understand how the system works without seeing it?
- Did I avoid step-by-step actions (those belong in the Approach)?

4.2 Method (step-by-step numbered list)

In this section you will inform the reader about what you did in your experiment.

Tips

- Use past tense verbs (you already performed the actions).
- The list must precisely reflect what you did during the experiment, so if another student would follow the steps, they would get the same results.
- Write in third person (e.g., “the water was heated” instead of “I heated the water”).
- Numbered or clearly indicated steps are fine, but each step should be a full sentence or two, not just a phrase or a few words.
- Include tools, instruments, and checks (for example, mention if you used a thermometer).

Example of transformation

Too short / bullet-style:

1. Boil water.
2. Put a teabag in a cup.
3. Pour hot water over it.
4. Wait 3 minutes.

Better & structured steps with sentences:

Step 1: The first step was to heat 250 milliliters of tap water using an electric kettle. To ensure that the water had reached boiling point, the temperature was verified with a digital thermometer.
Step 2: A teabag was then removed from its packaging and placed into a clean ceramic cup.
Step 3: Immediately after boiling, the water was poured into the cup, fully covering the teabag.
Step 4: The tea was left too steep for three minutes to allow flavor and color to develop. Once the steeping time had passed, the teabag was removed, and the tea was ready for measurement.
Step 5: The temperature of the tea was measured immediately after steeping and then again every five minutes for a total of fifteen minutes. All data were recorded carefully for later analysis.

5. Results

The Results section is the **core** of the report. It must present the measured data, the graphs, and the calculated parameters, and it must also include the **full theoretical discussion** explaining why the results look the way they do. Since there is no separate Discussion chapter, all interpretation and reasoning must be integrated here.

A strong and complete Results section contains the following elements:

5.1 Present the measured (raw) data clearly

All collected values must be shown in **numbered tables** such as *Table 1* or *Table 2*.

This includes:

- recorded input values
- recorded output values
- time measurements
- any additional relevant data

The tables must be referred to in the text ("As shown in Table 1…").

The goal of this part is to show **exactly what you measured** before processing or analyzing anything.

5.2 Insert and describe the graphs / step-response curves

Graphs must be numbered (*Figure 1*, *Figure 2*…) and clearly labeled.

Each figure should have:

- a descriptive caption
- a short explanation of what the graph shows

Example description:

"Figure 2 shows the rising step response, where the output increases smoothly toward a new steady state."

This description is factual and focuses only on what is visible.

5.3 Show the processed data and calculated parameters

After the raw data and graphs, you present the computed values such as:

- Gain (K)
- Time constant (T)
- Delay time (τ)
- Any averaged values from multiple tests

These must be placed in a separate table, e.g. *Table 3: Calculated System Parameters*.

This table shows what the experiment produced in numerical form.

5.4 Provide the full theoretical discussion

Since there is **no separate Discussion chapter**, the Results section must also include the complete theoretical interpretation of the results.

This part explains:

Why the curves look the way they do

- Are the step responses typical for the system type studied?
- Do they match known theoretical shapes (e.g., first-order curves, S-shaped curves, saturation, nonlinearity)?

Why the calculated parameters make sense

- Does the gain match the observed change in output?
- Is the time constant consistent with how quickly the system responds?
- Is the delay time visible in the graph?

How the results compare with theory learned in lectures

- Do the obtained values fit the expected model?
- Does the system behave like a textbook example of its type?
- Are any deviations logically explainable (e.g., noise, valve nonlinearity, measurement lag)?

Discuss differences between tests (if any)

- If rising and falling curves give slightly different parameters, explain why.
- If one controller produces faster or slower responses, connect this to theory.

This section should be written in full sentences, not bullet points, and should show **understanding**, not just numbers.

5.5 Explain why the results are reasonable

Students must clearly state whether the results:

- follow the expected trends
- support the theoretical model
- show expected dynamic behaviour

This is where they demonstrate that they **understand** the system, not just measured it.

6. Conclusion

The conclusion summarizes the experiment briefly and clearly. Restate that the step responses were successfully or unsuccessful obtained and processed, that the parameters (K), (T), and (τ) were determined, and if the created controller represents a theoretical controller from the lectures and if the dynamic behavior of the water tank coincides with that. The conclusion must be short and must not introduce new material not already presented in the results.

These parts **should** be included for making a good conclusion:

- A brief restatement of the experiment's overall purpose.
- A short summary of the key findings or results.
- A statement explaining what the results mean in relation to the objective.
- A comment on whether the experiment achieved what it set out to do.
- A reflection on the reliability or quality of the results (brief, not detailed).
- A mention of any major insights or understanding gained.
- A final closing sentence that wraps up the report clearly.

Example Conclusion (different topic):

The purpose of this experiment was to study how the mass attached to a spring affects the oscillation period in a simple harmonic motion system. The measurements collected for different masses allowed the oscillation periods to be calculated accurately, and the resulting data showed a clear trend: as the mass increased, the oscillation period also increased. This behaviour is consistent with the theoretical model presented in lectures, which states that the period of a mass–spring system is proportional to the square root of the mass divided by the spring constant.

The experiment achieved its objective by demonstrating this relationship clearly. The plotted results closely followed the theoretical curve, suggesting that the setup and measurement techniques were effective and reliable. Although small deviations occurred likely due to friction, timing inaccuracies, or slight variations in how the mass was released these did not change the overall pattern or the validity of the findings.

Overall, the experiment provided a solid practical understanding of simple harmonic motion. It confirmed the expected relationship between mass and oscillation period and reinforced how theoretical formulas can be applied to real physical systems. The experience also highlighted the importance of careful measurement and consistent methodology when studying dynamic behavior.

7. Figures

When using figures such as pictures, tables or formulas in a report it is important to refer to them. Refer to these pictures as Figure1, Figure 2, etc. Always making sure it is in chronological order and stated below the picture. A new chapter cant also have a Figure 1 if this has already been used.

Tables can also be used in a report, a table should be referenced as Table 1, Table 2, etc. This should be stated above the table.

It's also very important to refer to figures when writing the report, a figure is only helpful when it is referenced in the text, otherwise the figure does not add value to the report.

For example when referencing to a figure use sentences as: 'in *this experiment we want to see how long it takes for a cup of tea to cool down when it is in a mug. This setup for this experiment can be seen below in figure 1. After analyzing the test results we combined this into table 1.*' Equations can be referred to as: '*these values were obtained by using equation 1. This can be seen below.*'

Figure 1: Test setup

Table 1: Temperature change

Time (Minutes)	Temp. (°C)
0	90
2	78
4	70
6	64
8	60
10	57
12	55
14	53
16	52
18	51
20	50

$$G(s) = \frac{K_{avg}}{T_{avg}s+1}\, e^{-\tau_{avg}s}$$

Equation 1