Simple harmonic motion

Identification page

Instructions: Print this page and the following ones before your lab session to prepare your lab report. Staple them together with your graphs at the end. If you forgot to print it before your lab, you can reproduce it by hand but you have to follow the exact format (same number of pages, same items on each page, same space to answer question).

Complete <u>all the identification fields below</u> or 10% of the lab value will be deduced from your final mark for this lab.

For in-lab reports, hand in your report to your demonstrator at the end of the sessions or you will receive a zero for this lab.

For take-home reports, drop your report in the right box or 10% of the lab value will be deduced from your mark. Refer to the *General information* document for the details of the late report policy.

Experiment title: Simple harmonic motion ______________________

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Name: ______________________

Student number: ______________________

Lab group number: ______________________

Course code: PHY ______________________

Demonstrator: ______________________

Date of the lab session: ______________________

Partner's name: ______________________

Data sheet

Instructions: This lab report is due at the end of the lab session. We recommend completing the *Data sheet* before starting the *Questions* section.

Preliminary manipulations

[4] Fill the following table:

Table 1 – Fit parameters for $x(t)$, $v(t)$, $a(t)$, and $F(t)$.

Graph	Parameter A, Amplitude (m)	Parameter B, ω (rad/s)	Parameter C, Phase constant (rad)
$x(t)$			
$v(t)$			
$a(t)$			
$F(t)$			

[2] Compare the positions of the maxima and minima of the $x(t)$ and $F(t)$ curves. What do you observe? Can you explain it? How does this relate to the parameters A, B or C?

[2] Compare the positions of maxima and minima of the $a(t)$ and $F(t)$ curves. What do you observe? Can you explain it? How does this relate to the parameters A, B or C?

Part 1 - Spring constant from static measurements

[4] Fill the following table:

Table 2 – Spring elongation as a function of suspended mass

Hanging mass description	Mass added on the hanger, m (g)	Extending force, mg (N)	Displacement, Δy (m)
$\approx$ 100 g			
$\approx$ 200 g			
$\approx$ 300 g			
$\approx$ 400 g			
$\approx$ 500 g			

[4] Prepare Graph 1. Submit it online before the end of the lab session.

Find the static spring constant of your harmonic spring:

$k_{\text{static}} = (\_\_\_\_\_\_\_\_\_\_ \pm \_\_\_\_\_\_\_\_\_\_)$

Part 2 - Spring constant from dynamic measurements

[1] Measure the masses of the mass hanger and the spring.

$m_{\text{hanger}} = (\_\_\_\_\_\_\_\_\_\_ \pm \_\_\_\_\_\_\_\_\_\_)$

$m_{\text{spring}} = (\_\_\_\_\_\_\_\_\_\_ \pm \_\_\_\_\_\_\_\_\_\_)$

[4] Fill the following table:

Table 3 – Spring oscillation parameters as a function of suspended mass

Hanging mass description	Total hanging mass (hanger + masses), m (g)	Angular frequency of oscillation, ω (rad/s)	Period of oscillation squared, T^2 (s^2)
Hanger + $\approx$ 100 g			
Hanger + $\approx$ 200 g			
Hanger + $\approx$ 300 g			
Hanger + $\approx$ 400 g			
Hanger + $\approx$ 500 g			

[4] Prepare Graph 2. Submit it online before the end of the lab session.

Part 3 - Amplitude vs. frequency of oscillations

[3] Fill the following table:

Table 4 - Amplitude vs. frequency of oscillations

<table>
<tr><th>Suggested amplitude (m)</th><th>Amplitude of oscillation, A (m)</th><th>Angular frequency of oscillation, ω (rad/s)</th></tr>
<tr><td>0.01 m < A < 0.02 m</td><td></td><td></td></tr>
<tr><td rowspan="3">0.02 m < A < 0.10 m</td><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>0.10 m < A < 0.12 m</td><td></td><td></td></tr>
</table>

Questions

Preliminary manipulations

[2] What do you observe regarding the parameter B for the four curves? Explain.

[2] What is the relationship between parameter A for the $x(t)$, $v(t)$ and $a(t)$ graphs?

Part 2 - Spring constant from dynamic measurements

[2] From the slope of your Graph 2, find the dynamical spring constant, k, of your harmonic spring (with uncertainty).

[2] From the y-intercept of your Graph 2, find the correction factor, γ, of your harmonic spring (with uncertainty).

Part 3 - Amplitude vs. frequency of oscillations

[2] Does the period depend on the amplitude for this particular range of amplitudes (0.01 m – 0.12 m)?

Total : ________ / 38 (for the report and graphs)