Student Code						

Parallel Dipole Line Magnetic Trap for Earthquake & Volcanic Sensing (10 points)

A. BASIC CHARACTERISTICS OF PDL TRAP

1. **Determination of the magnet's magnetization (M) (2.5 pt.)**

Question	Answer	Marks
A.1 0.1 pt.	Record zero offset (B_0) of the Teslameter without any magnet nearby. Subtract subsequent field measurement with this value. B_0 =	
A.2 1.15 pt.	Measure magnetic field *B* vs. *x in the near field region* ($7 \leq x \leq 16$ mm) ! Where *x* is the position measured from the center of the magnet. Record and plot your result on the answer sheet.	

A.3 0.75 pt.	Use your experimental data to determine the value of the exponent p. p =	
A.4 0.5 pt.	Determine the magnet's magnetization *M*. M =	

2. The Magnetic Levitation effect and Magnetic Susceptibility (ξ) (1.0 pt.)

Question	Answer	Marks
A.5 0.1 pt.	Place gently a graphite rod HB/0.5 and length = 8 mm in the trap. Measure the levitation height y_0 of the rod (see Fig. 7a)! Hint: Use the insert ruler provided as shown in Fig. 7b. Press the ruler on the magnets to read the position of the graphite rod. y_0 =	
A.6 0.8 pt.	Use the result from part A.5 to determine the magnetic susceptibility χ of the graphite rod. χ =	
A.7 0.1 pt.	What kind of magnetic material is graphite? Choose one: (i) Ferromagnetic; (ii) Paramagnetic; or (iii) Diamagnetic?	

3. The camelback potential oscillation and magnetic susceptibility (χ)

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>A.8

0.2 pt.</td><td>Perform an oscillation for the "HB/0.5" graphite and l = 8 mm. Limit to small oscillation amplitude i.e. A < 4 mm. Determine the oscillation period. (The oscillation will decay over time due to damping, ignore this damping effect).
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<tr><td>A.9

0.8 pt.</td><td>Calculate the magnetic susceptibility (χ) of the graphite using this oscillation.

χ =</td><td></td></tr>
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<u>4. Oscillator quality factor (Q) and estimate of air viscosity</u> μ_A (4.0 points)

Question	Answer	Marks
A.10 0.5 pt.	We need to determine the damping time constant of the oscillation τ. Sketch how you measure τ in *a simple way*!	
A.11 1.5 pt.	Perform oscillation damping experiments with a group of rods with various diameters and fixed length of 8 mm. Determine the damping time constant τ for each rods	

A.12 1.0 pt.	Determine the air viscosity μ_A . μ_A =	

B. SENSOR APPLICATION OF THE PDL TRAP

5. PDL Trap Seismometer (0.5 pt.)

Question	Answer	Marks
B.1 0.2 pt.	Which diameter of rod do you choose?	
B.2 0.3 pt.	Calculate the seismometer acceleration noise floor (a_n) for the rod of your choice.	

6. PDL Trap Tiltmeter (2 pt.)

Question	Answer	Marks
B.3 0.5 pt.	Derive the relation theoretically between displacement Δz with the screw thread size S and the number of turns (N).	

B.4

1.25 pt.

By turning the screw slowly, determine the rod displacement Δz vs. the number of screw turns (N). Determine the thread size S.

S =

B.5

0.25 pt.

When the ground tilt changes we want the graphite rod to go to equilibrium as fast as possible (instead of sustaining very long oscillation) to allow easy reading. What is the ideal Q factor for a tiltmeter?

Q =