



**PROBLEM E1** 

## Problem E1. Electric guitar (20 points)

#### Part A. String dimensions (2 points)

For length  $l_1$ , directly measured quantities and calculations:

Length  $l_1$  and its uncertainty:

For string diameter d, directly measured quantities and calculations:

String diameter d and its uncertainty:

Part B. Resistivity (3 points)

 $Draw\ measurement\ circuit(s):$ 

For string resistivity  $\rho$ , directly measured quantities, calculations and multimeter settings:

String resistivity  $\rho$  and its uncertainty:



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**PROBLEM E1** 

#### Part C. String oscillations (3 points)

Draw measurement circuit(s):

#### Measurements and calculated data (you don't have to fill the entire table):

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Graph: $f$ versus $l$				



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# Part D. Young modulus of the string (4.5 points)

Suitable axes for finding Young modulus from graph expressed by known quantities:  $\mathbf{x}$ =

y =

Calculated data for the graph(you don't have to fill the entire table):





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#### Part E. Heated string (3 points)

Draw measurement circuit(s):

Measurements and calculated data (you don't have to fill the entire table):


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Graph: $f$ versus $T$				



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### Part F. Thermal expansion of the string (4.5 points)

Suitable axes for finding coefficient of linear heat expansion  $\alpha$  from graph expressed by known quantities: x=

y =

Calculated data for the graph(you don't have to fill the entire table):


