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B. Results and data analysis (58 pts)

Part I. Measurement of Work and Energy

Table 1 Measurement of Work and Energy (13 pts)

Mass of the car, $m_{\text{car}} =$ _____

Length of the inclined plane, $L =$ _____

Incline angle	Total mass, up ()	F_u ()	Total mass, down ()	F_d ()	Height, h ()	f_k ()

Table 2 Calculation of Work and Energy (13 pts)

Incline angle	$F_u L$ ()	$f_k L$ ()	ΔGPE ()	$f_k L + \Delta\text{GPE}$ ()	Percent difference* between $F_u L$ and ($f_k L + \Delta\text{GPE}$)

* Since both $F_u L$ and $(f_k L + \Delta\text{GPE})$ are measured results, neither of them is more reliable than the other one. In this case, when calculating the Percent difference, we take the average of the two as the denominator in the formula:

$$\text{Percent difference} = \frac{|F_u L - (f_k L + \Delta\text{GPE})|}{(F_u L + f_k L + \Delta\text{GPE})/2} \times 100\%$$

Part II. Measurement of the coefficients of kinetic and static friction

Table 3 The coefficient of friction measured on a flat surface (13 pts)

Mass of the car, $m_{\text{car}} =$ _____

Experimental Arrangement	Mass required to pull the car ()	Force of Friction ()	Coefficient of friction
Sliding friction		$f_k =$	$\mu_k =$
Static friction		$f_s =$	$\mu_s =$

Table 4 The coefficient of friction measured on an inclined plane (13 pts)

Mass of the car, $m_{\text{car}} =$ _____

Experimental Arrangement	Limiting angle	Coefficient of friction
Rolling friction		$\mu_{k, \text{rolling}} =$
Sliding friction		$\mu_{k, \text{sliding}} =$
Maximum static friction		$\mu_s =$

Calculation of percent difference (6 pts):

i. Coefficient of sliding kinetic friction μ_k :

ii. Coefficient of static friction μ_s :

TA signature:

C. Answer the following questions after the experiment (6 pts each)

- In part I of the experiment, the incline angle affects the frictional force involved in pulling the car up the plane. Show how the frictional force depends on the incline angle.

5. Does the Work-Energy Theorem (Eq. (1)) hold when moving the car along the inclined plane? Specify one set of data from your measurements to support your answer. Discuss the possible sources of error in this part of the experiment.
6. In part II of the experiment, did you see any difference between the coefficient of rolling friction and the coefficient of sliding friction? What do your results indicate about the relative advantage of rolling, over sliding, an object up an incline?
7. Assume you add a large weight to the car, and thereby increase the normal force F_n , in the measurement of the coefficient of rolling friction μ_k . Do you expect any difference in the measured value of μ_k ? Explain.