Supplemental Information
Conservation of Momentum

1. Required Data and Tables

(a) Flag Measurement - \( w, W \)
(b) Masses - \( m, M \)
(c) Collision Data

<table>
<thead>
<tr>
<th>Collision Type</th>
<th>( t_i )</th>
<th>( t_f )</th>
<th>( v_i )</th>
<th>( v_f )</th>
<th>( T_i )</th>
<th>( T_f )</th>
<th>( V_i )</th>
<th>( V_f )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elastic (Big hits Small)</td>
<td></td>
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<tr>
<td>Elastic (Small hits Big)</td>
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<tr>
<td>Inelastic (Big hits Small)</td>
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</tbody>
</table>

(d) Collision Analysis

<table>
<thead>
<tr>
<th>Collision Type</th>
<th>( m = )</th>
<th>( M = )</th>
<th>System Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( p_i )</td>
<td>( p_f )</td>
<td>( ke_i )</td>
</tr>
<tr>
<td>Elastic (Big hits Small)</td>
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<tr>
<td>Elastic (Small hits Big)</td>
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</tbody>
</table>

2. Error Analysis

- All error calculations will be due only to error in measurement of mass (\( \Delta m = 1 \) g), and error in measurement of width of flag (\( \Delta w, \Delta W = 0.1 \) cm).
- Calculate \( \Delta p_i, \Delta p_f, \Delta P_i, \Delta P_f, \Delta ke_i, \Delta ke_f, \Delta KE_i, \Delta KE_f \), and total errors for each system total.
- Use:

\[
\Delta v = v \frac{\Delta w}{w}
\]

\[
\Delta p = \frac{1}{2}[(m + \Delta m)(v + \Delta v) - (m - \Delta m)(v - \Delta v)]
\]

\[
\Delta ke = m\Delta v + v\Delta m
\]

\[
\Delta KE = \frac{1}{2}(m + \Delta m)(v + \Delta v)^2 - \frac{1}{2}(m - \Delta m)(v - \Delta v)^2
\]

Total \( \Delta KE_i = \Delta ke_i + \Delta KE_i \)

Total \( \Delta P_i = \Delta p_i + \Delta P_i \)

3. Guide Questions

(a) For each collision experiment you performed,

i. Where do the gliders go after collision? In the same, or opposite to the incident direction?
ii. Was total momentum conserved? Does Total \( P_i \pm \Delta P_i \) overlap with Total \( P_f \pm \Delta P_f \)?
iii. Was total energy conserved? Does Total \( KE_i \pm \Delta KE_i \) overlap with Total \( KE_f \pm \Delta KE_f \)?
iv. Calculate in each case percent difference \( 100 \times \frac{(P_f - P_i)}{P_i} \) and \( 100 \times \frac{(KE_f - KE_i)}{KE_i} \)

(b) Based on your results, what is the main difference between elastic and inelastic collisions? Does it agree with what you discussed in lecture?