“BOUNCING BALL” LAB PART ONE: POTENTIAL AND KINETIC ENERGY

MATERIALS: 1 TENNIS BALL 1 METERSTICK

STUDENT ROLES:

DROPPER: DROPS BALL TO BEGIN OBSERVATION, THEN OBSERVES HOW THE SPEED OF THE FALLING BALL CHANGES AFTER EACH BOUNCE

MEASURER 1: MEASURES AND RECORDS THE GREATEST HEIGHT THAT THE BALL REACHES AFTER ITS 1ST BOUNCE AND ITS 3RD BOUNCE

MEASURER 2: MEASURES AND RECORDS THE GREATEST HEIGHT THAT THE BALL REACHES AFTER ITS 2ND BOUNCE.

PROCEDURE:

1. THE DROPPER HOLDS THE BALL AT THE 160cm TAPE MARK ON THE WALL, 6-8 INCHES FROM THE WALL. ONE MEASURER HOLDS THE METER STICK UP AGAINST THE WALL.

2. THE DROPPER SHOULD STAND IN FRONT OF THE METER STICK, THE MEASURERS SHOULD STAND TO EACH SIDE OF THE METER STICK, MAKING SURE THAT THEY CAN CLEARLY SEE THE MARKINGS ON THE STICK.

3. WHEN BOTH MEASURERS ARE READY, THE DROPPER SHOULD DROP THE BALL. AS THE BALL FALLS AND BOUNCES, EACH PERSON IS RESPONSIBLE FOR THE FOLLOWING MEASUREMENTS, AND FOR RECORDING THESE MEASUREMENTS IN THE APPROPRIATE PLACES IN THE DATA SHEET:

DROPPER: DROPS BALL TO BEGIN OBSERVATION.

MEASURER 1: MEASURES AND RECORDS THE GREATEST HEIGHT THAT THE BALL REACHES AFTER ITS 1ST BOUNCE (BOX 3 OF DATA SHEET) AND AFTER ITS 3RD BOUNCE (BOX 7 OF DATA SHEET)

MEASURER 2: MEASURES AND RECORDS THE GREATEST HEIGHT THAT THE BALL REACHES AFTER ITS 2ND BOUNCE (BOX 5 OF DATA SHEET)

REPEAT THE PROCEDURE 2 OR 3 TIMES TO ENSURE ACCURACY, AND THEN RECORD THE FOLLOWING DATA ON THE DATA SHEET:

4. RECORD THE HEIGHTS OF EACH BOUNCE IN BOXES 3, 5, & 7

5. CONVERT THE HEIGHTS FROM CENTIMETERS TO METERS IN BOXES 9-16

6. USE EACH OF THE HEIGHTS IN METERS TO CALCULATE THE POTENTIAL ENERGY OF EACH BOUNCE IN BOXES 17-24 (Do this at home or after you finish the practical part of the lab)

7. PROCEED TO PART TWO. DO NOT YET FILL IN BOXES 25-40 - YOU WILL FILL THESE IN AS YOU COMPLETE PART TWO.
“BOUNCING BALL” LAB PART TWO: HEIGHT AND VELOCITY

HYPOTHESES:
1. AN OBJECT DROPPED FROM A GREAT HEIGHT WILL ACHIEVE A ________________ VELOCITY
2. DROPPING THAT SAME OBJECT FROM A LESSER HEIGHT WILL RESULT IN A ________________ VELOCITY

IN THIS PART OF THE LAB, YOU WILL DROP YOUR TENNIS BALL FROM EACH OF THE HEIGHTS THAT YOU RECORDED IN BOXES 1, 3, 5, 7 ON YOUR DATA SHEET

1. HOLD THE BALL AT A HEIGHT OF 160 CM., AND USE A STOPWATCH TO TIME HOW LONG THE BALL TAKES TO REACH THE GROUND.

2. RECORD TIME IN THE “TIME 1” BOX BELOW.

3. DROP THE BALL 2 MORE TIMES FROM THIS HEIGHT, RECORDING TIMES IN THE “TIME 2” AND “TIME 3” BOXES C-D.

4. TAKE THE AVERAGE OF THE TIMES, AND RECORD IN THE “AVG. TIME” BOX:

   \[
   \text{AVERAGE TIME} = \frac{(\text{TIME 1} + \text{TIME 2} + \text{TIME 3})}{3}
   \]

5. DIVIDE THE HEIGHT OF THE DROP BY THE AVERAGE TIME. RECORD THIS IN THE “VELOCITY” BOX - USE THE UNITS “CENTIMETERS PER SECOND”

6. CONVERT YOUR VELOCITY IN CENTIMETERS/SECOND TO METERS / SECOND, AND ENTER IN BOX G.

7. REPEAT STEPS 1-5 FOR EACH OF THE HEIGHTS THAT YOU RECORDED IN BOXES 3, 5, AND 7 OF THE DATA SHEET.

<table>
<thead>
<tr>
<th>A. HEIGHT OF DROP/BOUNCE</th>
<th>B. TIME 1 (SECONDS)</th>
<th>C. TIME 2 (SECONDS)</th>
<th>D. TIME 3 (SECONDS)</th>
<th>E. AVERAGE TIME: (T1+T2+T3)÷3</th>
<th>F. VELOCITY IN CM/SEC. (BOX A ÷ BOX E)</th>
<th>G. VELOCITY IN METERS/SEC. (BOX F ÷ 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>160 cm.</td>
<td></td>
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<td></td>
<td>velocity A</td>
<td></td>
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<td>velocity B</td>
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<td>velocity C</td>
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<td>velocity D</td>
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</table>

8. DOES YOUR DATA MATCH YOUR HYPOTHESES? ________________

9. IF NOT, WHAT DO YOU THINK IS THE SOURCE OF ERROR IN THIS PART OF THE LAB?:
“BOUNCING BALL” LAB ANALYSIS QUESTIONS- BE SURE TO EXPLAIN YOUR ANSWERS!!!

1. AT WHICH POINT DURING THE LAB WAS THE BALL’S POTENTIAL ENERGY THE HIGHEST?

2. GIVEN THAT POTENTIAL ENERGY = MASS \cdot GRAVITY \cdot HEIGHT, WHY WAS IT HIGHEST AT THIS POINT?

3. AT WHICH POINT DURING THE LAB WAS THE BALL’S KINETIC ENERGY THE HIGHEST?

4. GIVEN THAT KINETIC ENERGY = \frac{1}{2} \text{ MASS} \cdot \text{ VELOCITY}^2, WHY WAS IT HIGHEST AT THIS POINT?

5. LOOK AT THE GRAPH, AND STUDY BOTH LINES TOGETHER. DOES THERE APPEAR TO BE A RELATIONSHIP BETWEEN THE BALL’S POTENTIAL ENERGY AND KINETIC ENERGY LEVELS? HOW ARE THEY DIFFERENT/SIMILAR? DESCRIBE AND EXPLAIN WHAT YOU SEE:

6. IF POTENTIAL ENERGY IS “GONE” WHEN THE BALL REACHES THE GROUND, AND ENERGY CANNOT BE “LOST” OR DESTROYED, THEN WHAT HAPPENED TO THE BALL’S POTENTIAL ENERGY? (WHERE DID IT “GO”?)


8. IMAGINE THAT THE PEAKS OF EACH LINE (K.E. AND P.E.) WERE EQUAL. WHAT WOULD EXPLAIN THIS? WHAT WOULD THESE GRAPHS INDICATE ABOUT THE BALL’S BEHAVIOR AND ITS ENERGY LEVELS?

9. EXPLAIN WHY THE FOLLOWING STATEMENT IS FALSE: “AN OBJECT WITH A HIGH KINETIC ENERGY CANNOT HAVE A HIGH POTENTIAL ENERGY AS WELL”. YOU MAY USE EXAMPLES TO SUPPORT YOUR EXPLANATION.

10. WHY DOES THE OBJECT IN THIS LAB ONLY HAVE A HIGH K.E. WHEN ITS P.E. IS LOW? (OR, WHY AREN’T EACH OF ITS ENERGY LEVELS HIGH AT THE SAME TIME?)
### DATA SHEET: “BOUNCING BALL” LAB

**IMPORTANT**: FOR ALL CALCULATIONS: MASS OF BALL = 50 (GRAMS), GRAVITY = 9.8 (METERS/SECOND²)**

<table>
<thead>
<tr>
<th>Height Before Drop</th>
<th>Height Before Drop</th>
<th>Potential Energy Before Drop</th>
<th>Velocity Before Drop</th>
<th>Kinetic Energy Before Drop</th>
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</thead>
<tbody>
<tr>
<td>160 cm.</td>
<td>160 cm.</td>
<td>50<em>9.8</em>0 m=</td>
<td>0</td>
<td>½ M • V² =</td>
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<td>2.</td>
<td>2.</td>
<td>50<em>9.8</em>0 m=</td>
<td>0</td>
<td>½ M • V² =</td>
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<td>3.</td>
<td>3.</td>
<td>50<em>9.8</em>0 m=</td>
<td>0</td>
<td>½ M • V² =</td>
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<td>4.</td>
<td>4.</td>
<td>50<em>9.8</em>0 m=</td>
<td>0</td>
<td>½ M • V² =</td>
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<td>5.</td>
<td>5.</td>
<td>50<em>9.8</em>0 m=</td>
<td>0</td>
<td>½ M • V² =</td>
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<td>6.</td>
<td>6.</td>
<td>50<em>9.8</em>0 m=</td>
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<td>½ M • V² =</td>
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<td>7.</td>
<td>7.</td>
<td>50<em>9.8</em>0 m=</td>
<td>0</td>
<td>½ M • V² =</td>
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<td>8.</td>
<td>8.</td>
<td>50<em>9.8</em>0 m=</td>
<td>0</td>
<td>½ M • V² =</td>
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**Notes:**
- **GROU** with height at 8 cm.
- **HEIGHT AT PEAK OF 1ST BOUNCE:**
- **HEIGHT AT PEAK OF 2ND BOUNCE:**
- **HEIGHT AT PEAK OF 3RD BOUNCE:**
- **HEIGHT AT PEAK OF 4TH BOUNCE:**
- **IMPACT:**
- **BOUNCE:**
- **VELOCITY AT PEAK OF 1ST BOUNCE:**
- **VELOCITY AT PEAK OF 2ND BOUNCE:**
- **VELOCITY AT PEAK OF 3RD BOUNCE:**
- **VELOCITY AT PEAK OF 4TH BOUNCE:**
- **VELOCITY BEFORE DROP:**
- **VELOCITY OF DROP:**
- **OK**
- **POTENTIAL ENERGY AT 1ST IMPACT:**
- **POTENTIAL ENERGY AT 2ND IMPACT:**
- **POTENTIAL ENERGY AT 3RD IMPACT:**
- **POTENTIAL ENERGY AT 4TH IMPACT:**
- **VELOCITY OF FALL AFTER 1ST BOUNCE:**
- **VELOCITY OF FALL AFTER 2ND BOUNCE:**
- **VELOCITY OF FALL AFTER 3RD BOUNCE:**
- **VELOCITY OF FALL AFTER 4TH BOUNCE:**
- **DATA SHEET: “BOUNCING BALL” LAB**
- **KINETIC ENERGY AT PEAK OF 1ST BOUNCE:**
- **KINETIC ENERGY AT PEAK OF 2ND BOUNCE:**
- **KINETIC ENERGY AT PEAK OF 3RD BOUNCE:**
- **KINETIC ENERGY AT PEAK OF 4TH BOUNCE:**

**Important Calculations:**
- **M • G • H =**
- **½ M • V² =**
- **VELOCITY:**
- **POTENTIAL ENERGY:**
- **KINETIC ENERGY:**

**Units:**
- **HEIGHT IN CM ÷ 100 METERS:**
- **10 =**

**Calculations:**
- **BEFORE DROP:**
- **M • G • H =**
- **VELOCITY:**
- **POTENTIAL ENERGY:**
- **KINETIC ENERGY:**

**Participants:**
- **THIRD:**
- **SECOND:**
- **FIRST:**

**Conclusion:**
- **For all calculations:**
- **Mass of ball:** 50 grams, **Gravity:** 9.8 meters/second².
GRAPHING DIRECTIONS

1. After completing the lab and all data sheet calculations, use the graph paper provided to graph your data.

2. Note that the x axis values are provided for you – they are the 8 “steps” in the ball’s motion, as shown in the diagram below. Each of these “steps” has its own horizontal row in the data table.

3. First, graph a SOLID line for your POTENTIAL ENERGY DATA. Your Y axis values will be the values that you calculated in boxes 17-24 of your data sheet.

BE SURE THAT YOU PLOT THESE VALUES WITH THE CORRESPONDING X AXIS VALUES!

4. Next, graph a DASHED line for your KINETIC ENERGY DATA. Your Y axis values will be the values that you calculated in boxes 33-40 of your data sheet.

BE SURE THAT YOU PLOT THESE VALUES WITH THE CORRESPONDING X AXIS VALUES!

5. After completing your graph, complete the analysis questions sheet.

-------------------------------------------------------------------------------

USE THE GRAPHIC BELOW AS A GUIDE WHEN GRAPHING.

THE #'S IN THE PICTURES OF THE BALL CORRESPOND TO DATA SHEET BOXES #S 1-8
# BOUNCING BALL GRAPH: POTENTIAL AND KINETIC ENERGY

<table>
<thead>
<tr>
<th>Time (s)</th>
<th>Height (m)</th>
<th>Velocity (m/s)</th>
<th>Energy (J)</th>
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