**Momentum** names:

physical Science

SRCS ~Mr. e

**Problem:** How slow does Mr. E's Saturn need to drive in order to equal the momentum of your pitch?

**Materials:** Baseball /softball Gloves (pair per group)

 Writing Utensil Stopwatch/timer

 Meter stick Data Sheet

 Calculator

**Procedure:**

1. Record data for Mr.e's Saturn and measure the mass of your projectile in table 1; specify if it is a baseball or a softball and include units in all measurements.
2. Convert mass of ball from grams to kilograms; record in table 1. (Show all work on p. 3)
3. Select a thrower, catcher and timer.
4. Obtain necessary materials from instructor; each group is responsible for transporting, maintaining, and returning all materials to instructor. (note: entire group must use the same ball)
5. Select an appropriate throwing distance between thrower and target.
6. Measure this distance in meters, record in table 2; keep in mind that you must measure hand to hand, not foot to foot.



distance (m)

1. Throw and time three good pitches making sure to:
	1. Throw as reasonably hard/consistent as you can.
	2. Throw the same distance each time (eg. hands of pitcher AND catcher extended to distance lines).
	3. Timer: start time once ball leaves hand; stop timer once ball reaches glove.
	4. Record all data on table 2 INCLUDING UNITS; write all names next to the letters in table 2.
2. Repeat until each member has three trials or 12 total trials are recorded amongst your group members.
3. Take supplies and return to classroom.
4. Calculate your avg. time per three trials, and your corresponding velocity (Show all work); record in table 2; share with other group members.
5. Calculate the group average v from all four calculated individual avg. v's. (Show all work)
6. Use data from Table 2 (group avg. v) to fill in ball v and calculate the ball's momentum; record in data table1.
7. Use conservation of momentum law to find the speed of the Saturn by setting the momentum of the ball equal to the momentum of the Saturn and calculating the car's v; show all work and record in table 2.
8. Answer questions below in complete sentences.

**Data Tables**



**TABLE 1**

|  |  |  |  |
| --- | --- | --- | --- |
| **Object** | **Mass (kg)** | **v (m/s)** | **Momentum (kg x m/s)** |
| **Baseball/softball****(circle which)** |  |  **(group avg. v)** |  |
| **Saturn** | **1,114 kg** |  |  |

**TABLE 2**

 **Trial time avg. t distance avg. v**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **A****1.** |  | **A** |  |  |
| **2.** |  |
| **3.** |  |
| **B****1.** |  | **B** |  |  |
| **2.** |  |
| **3.** |  |
| **C****1.** |  | **C** |  |  |
| **2.** |  |
| **3.** |  |  **Group****avg. v** |
|  **D****1.** |  | **D** |  |  |  |
| **2.** |  |
| **3.** |  |

**Calculations (show all work here)**

**Conversion of mass of ball**

 **\_\_\_\_\_\_\_\_\_\_\_\_\_ g x \_\_\_\_\_\_\_\_\_\_\_\_\_\_ = kg**



**Individual avg. time** (calculate your own) **t1+t2+t3/3**

**Individual avg. velocity** (calculate all) **d/avg. t**

**Group avg. velovity vA+vB+vC+vD/4\* \*depends on number of group members**

**Ball's momentum** (using group v) **momentum = mv**

**Car's necessary v momentumball = momentumcar**

**Car's momentum**

**Questions:**

1. **Would the Saturn be cruising or creeping along? Why?**



1. **Using your superior knowledge of impulse and all things "momentous" (see what I did there?), explain--in physical science terms, why a paintball breaks when it hits a person whereas remains whole if it skips across the grass? (the terms "hard" and "soft" are not acceptable answers here…)**