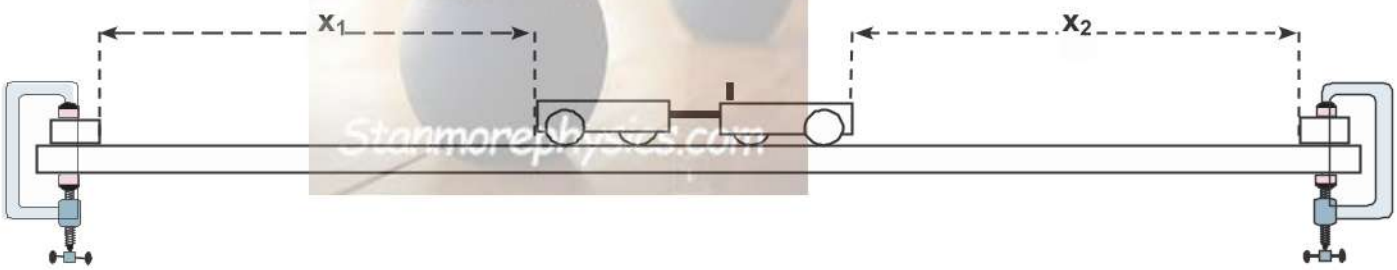
GAUTENG DEPARTMENT OF EDUCATION

PRESCRIBED EXPERIMENT	PHYSICAL SCIENCE GRADE 12	TERM 1 Week 4 at 13 hrs P 128: DO IN WEEK 4, BUT MARK IN TERM 2

KNOWLEDGE AREA: MECHANICS
TOPIC: MOMENTUM



Aim: To verify the conservation of linear momentum. (Page 100)

Apparatus: Two trolleys (each having their weight written on the side), Two 1 kg mass pieces, Runway or flat surface, 2 wooden blocks & clamps, Non-permanent marker pen, meter ruler / tape measure

Method:

1) The apparatus should be set up as per the diagram above
2) The trolleys' spring mechanisms should be loaded (note that only one spring loaded trolley is needed)
3) Place the trolleys back to back against each other so that the sides with the spring mechanisms are facing each other.
4) Use the marker and mark on the desk/runaway the position of each trolleys front wheel/ front edges
5) Release the spring mechanism by striking it with the wooden ruler.
6) Listen very carefully as the trolleys hit the wooden blocks.
7) If two distinct sounds are heard it means the trolleys did not reach the wooden blocks at the same time.
8) Move the trolley setup either left or right (depending on which trolley reached its' block first so that the trolleys will reach the blocks at the same time) and repeat instructions 5 & 6
9) Listen carefully

10) If it seems there is only one sound as the trolleys hit the wooden blocks it means they have reached their wooden blocks at the same time.

11) Measure the distance from the wooden block to the mark made for the front wheel/ front edge of trolley 1. Label this distance as x_1 and note the trolleys mass as m_1. Note that this distance will be the measure of the trolleys' velocity for this experiment.

12) Measure the distance from the wooden block to the mark made for the front wheel / front edge of trolley 2. Label this distance as x_2 and note the trolleys mass as m_2. Note that this distance will be the measure of the trolleys' velocity for this experiment.

13) Note the information you obtained in a table with the following headings.

	Trolley 1 (m_1)			**Trolley 1 (m_2)**			**Total momentum after explosion**
	Total mass	Distance x_1	Momentum $m_1 v_1$	Total mass	Distance x_2	Momentum $m_2 v_2$	
1							
2							
3							

14) Repeat instruction 1 to 13 but now add a 1 kg mass piece to one of the trolleys. (i.e. if you add the mass piece to trolley 1, $m_1 = x + 1$ kg) OR stack up a trolley with 1 trolley.

15) Repeat instructions 1 to 13 but now add two 1 kg mass pieces to one of the trolleys OR stack up a trolley with 2 trolleys.

Questions:

1	Why is the distances travelled by each trolley a good and acceptable indication of its velocity? Explain	(3)
2	Explain the importance of directions x_1 and x_2	(2)
3	What is the total momentum before the explosion in each case?	
4	What is the relationship between the total momentum before the collision and the total momentum after the collision? (you may round off your results)	(2)
5	State a conservation law which is reflected by this experiment.	(2)
6	Discuss the accuracy of this experiment and discuss any changes you would have made to have improved your results.	(4)
		[15]

Memo

Assessment of practical aspects:

1. Bumpers and trolleys set up to affect motion in a straight line. ✓
2. Experiment carried out on clean , smooth surface / track ✓
3. Trolleys released simultaneously. ✓
4. Initial positions of trolleys are correct. ✓
5. Positive and negative displacements recorded correctly in m. ✓

(5)

RESULTS:

	Trolley 1 (m_1)			**Trolley 1 (m_2)**			**Net momentum**
	Total mass (kg)	Distance x_1 (m)	Momentum $m_1 v_1$ (kg. m. s^{-1})	Total mass (kg)	Distance x_2 (m)	Momentum $m_2 v_2$ (kg. m. s^{-1})	(1) ✓ Headings & units
1	✓-	✓-	✓-	y	✓-	✓-	✓-
2	✓-	✓-	✓-	y	✓-	✓-	✓-
3	✓-	✓-	✓-	Y same	✓-	✓-	✓-

½ each (10)

Write up: correct format ✓- (aim, apparatus, method, results, analysis and interpretation and conclusion) Correct tense✓, method ✓✓, how errors were minimized ✓, (5)

1	Since the times taken by each trolley to reach the buffers are the same ✓ ✓, the distance travelled by each trolley (x) could represent the velocity because v = $\Delta s / \Delta t$✓ or since the times are the same v proportional to x ✓	(3)
2	Since momentum is a vector. + and – directions have to be specified.	(2)
3	Zero (0) ✓✓ both at rest	(2)
4	Equal / 0 ✓✓	(2)
5	The <u>total (linear) momentum remains constant</u>/is conserved ✓ in <u>an isolated</u>/a closed system/the absence of external forces. ✓ **Accept:** The total momentum before a collision equals the total momentum after a collision ✓ in a closed system. ✓	(2)
6	Minimize friction between wheels and surface, ✓ tilt the runway to compensate for friction, ✓ there is friction between wheels and axel, ✓ (oil the wheels) Repeat each explosion 2/3 times and take the average distances travelled by the trolleys ✓	(4)
	Total	**[35]**

RESULTS:

Sample 1

	Trolley 1 (m_1)			Trolley 1 (m_2)			Net momentum	
	Total mass (kg)	Distance x_1 (m)	Momentum $m_1 v_1$ (kg. m. s^{-1})	Total mass (kg)	Distance x_2 (m)	Momentum $m_2 v_2$ (kg. m. s^{-1})	(kg. m. s^{-1})	(1) ✓ Headings & units
1	0,598 ✓	0,575 ✓	- 0,344 ✓	0,588	0,578 ✓	0,339 ✓	- 0,005 ✓ ≈ 0	(3)
2	1,188 ✓	0,409 ✓	-0,486 ✓	0,588	0,743 ✓	0,437 ✓	- 0,049 ✓ ≈ 0	(3)
3	1,778 ✓	0,619 ✓	- 1,100 ✓	0,588	1,938 ✓	1,139 ✓	+ 0,039 ✓ ≈ 0	(3)

✓= ½ each

Sample 2

	Trolley 1 (m_1)			Trolley 1 (m_2)			Net momentum	
	Total mass (kg)	Distance x_1 (m)	Momentum $m_1 v_1$ (kg. m. s^{-1})	Total mass (kg)	Distance x_2 (m)	Momentum $m_2 v_2$ (kg. m. s^{-1})	(kg. m. s^{-1})	(1) ✓ Headings & units
1	1,1 ✓	0,390 ✓	- 0,429 ✓	1,1	0,390 ✓	0,429 ✓	0 ✓	(3)
2	2,1 ✓	0,256 ✓	- 0,538 ✓	1,1	0,527 ✓	0,580 ✓	+0,042 ✓ ≈ 0	(3)
3	3,3 ✓	0,180 ✓	- 0,594 ✓	1,1	0,618 ✓	0,680 ✓	+ 0,086 ✓ ≈ 0	(3)

✓= ½ each