LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

WATERBERG DISTRICT

PRESCRIBED EXPERIMENT

TERM 1

PHYSICAL SCIENCES

GRADE 12

TITLE: CONSERVATION OF MOMENTUM

SURNAME	
FIRST NAME(S)	
NAME OF SCHOOL	
NAME OF CIRCUIT	

Learner's Mark: _____ / 50

TERM 1 PRACTICAL WORK

KNOWLEDGE AREA: MECHANICS

CONSERVATION OF LINEAR MOMENTUM

INTRODUCTION

Momentum is mass in motion. The amount of momentum of an object is determined by two variables, **mass** and **velocity**.
Linear momentum (momentum in a straight line) can be defined as the product of mass and velocity.

SECTION A

The verification of the conservation of momentum can be determined experimentally during an **explosion** and a **collision**.

AIM:

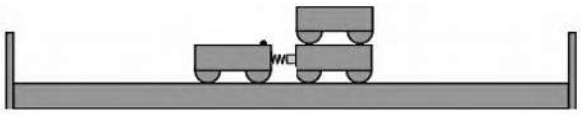
To verify the conservation of linear momentum during an explosion.

APPARATUS:

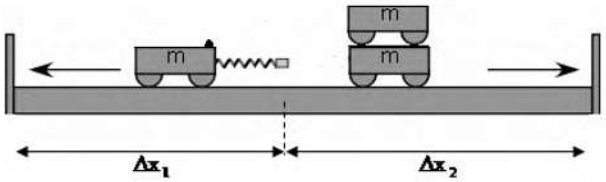
Trolley track/smooth surface.
Meter ruler/ long ruler.
Scale
Trolleys.
2 Buffers (wooden plank or brick).

METHOD:

1 Determine the mass of the trolleys.
2 Place two trolleys, one of which contains a compressed spring, against each other on a smooth, horizontal floor.
3 Place another trolley on top of one of the other trolleys in Step 1. These two trolleys now represent a mass of 2m, while the single trolley represents a mass of m.
4 Place two sturdy wooden planks on both sides of the set-up (not further than 1–1,5 m from the set-up) as indicated in the diagram below.



5 Release the spring of the one trolley so that the two trolley systems move apart. Listen to the collisions against the wooden planks. The trolley systems hit the wooden planks at different times, because the one trolley system moves more slowly than the other one because of different velocities.



6 By means of trial and error, find a position from which the trolley systems move so that both trolleys will hit the wooden planks on both sides at the same time. Only a single collision should be heard.

7 Measure the distances Δx_1 and Δx_2 that each trolley moved from the starting point to the wooden plank. These distances represent the velocities of the two trolley systems respectively.

8 Repeat the above-mentioned procedure to obtain two more sets of values.

9 Repeat the above procedure for different numbers of trolleys.

10 Record the information in a table and hand it in with the rubric.

Set up and measurements.

Criteria	0	1	2	Marks obtained
Execution of practical.	Needed a lot of assistance and support from the teacher to complete the practical.	Needed a little bit of assistance and support from the teacher to complete the practical.	Complete the practical without any assistance and support from the teacher.	
Set up and correct use of apparatus.	Set up of apparatus not correct.	Set up of apparatus is correct.	Set up correct and the two trolleys collided against barriers at the same time.	
Correct measuring of distances	Measurements are incomplete and inaccurate.	Measurements are correct and thorough.		
Correct recording of information.	No value correct.	Measurements was taken correctly.	Momentum before and after collision calculated correctly.	
Construction of table.	Record values, but not in a table.	Record values in table form.	Record values in table form, with a heading, column headings and units	
Safe use of apparatus.	Do not adhere to safety precautions.	Adhere to safety precautions.		

(10)

SECTION B

Example of table with results obtained from another investigation.

Trolley system 1			Trolley system 2			Total momentum after explosion ("unit")
Mass (Trolley unit)	[Velocity v_1] Distance Δx_1 (m)	Momentum ("unit")	Mass (trolley unit)	[Velocity v_2] Distance Δx_2 (m)	Momentum ("unit")	
2	0.8		2	0.8		
3	1.0		2	1.5		
4	1.2		2	2.4		

INTERPRETATION AND DISCUSSION OF RESULTS

1 Redraw the table, do the necessary calculations and complete it. (2)

2 Formulate an **investigative question** for this practical activity. (1)

3 State the **law** of conservation of momentum in words. (1)

4 Explain the term **isolated system**. (2)

5 Explain why it is acceptable to consider the distances travelled by the trolleys as a measurement of their **velocities**. (2)

6 Give a **reason** why this experiment must be performed more than once. (1)

7 Discuss the **safety precautions** that must be taken in consideration during this experiment. (1)

8 Identify the

a) dependent variable (1)

b) independent variable (1)

c) controlled variables for this experiment. (1)

9 Which physical quantities represents vector properties? (2)

10 Write down the unit for momentum. (1)

11 Give the NAME of the apparatus used to measure the mass of the trolleys. (1)

12 Identify the SI unit used to measure mass. (1)

13 Write down a conclusion for this experiment. (2)

[20]

SECTION C: APPLICATION (Post practical test)

14 Hendrick, mass 65 kg, on a roller skates, is holding an iron rod, mass 5 kg, in his hands. He is moving east on a horizontal, frictionless track with a speed of 1 $m \cdot s^{-1}$. To be able to move slower, he throws the iron rod away from him at a speed of 4 $m \cdot s^{-1}$. Ignore the effect of friction.

14.1 What is the total mass of the system? (1)

14.2 In which direction must Hendrick throw the iron rod to obtain a decrease in his velocity. (1)

14.3 Calculate the magnitude and direction of Hendricks velocity immediately after he has thrown the iron rod so that he obtained a maximum decrease in his velocity. (5)

15 A dummy, mass 50 kg, is placed on the driver's seat of a car during an experiment to investigate the effect of collisions. The car, mass 850 kg, starts from rest and accelerates to the right towards a wall. The car collides with the wall at a speed of 20 $m \cdot s^{-1}$.

15.1 When the car hits the wall, it comes to rest in 0.1 s. Calculate the magnitude of the average force exerted by the wall on the car. (6)

15.2 When the car hits the wall, the dummy carries on moving forward and collides with the windscreen. Name and state the relevant law of motion which explains this situation. (3)

15.3 The experiment is repeated with a car fitted with a large air bag between the dashboard and the dummy.

15.3.1 Will the magnitude of the force exerted by the air bag on the dummy **be greater than**, **less than** or the **same as** the magnitude of the force exerted by the dashboard? (1)

15.3.2 Explain briefly, by using appropriate physics concepts. (3)

[20]

TOTAL: 50