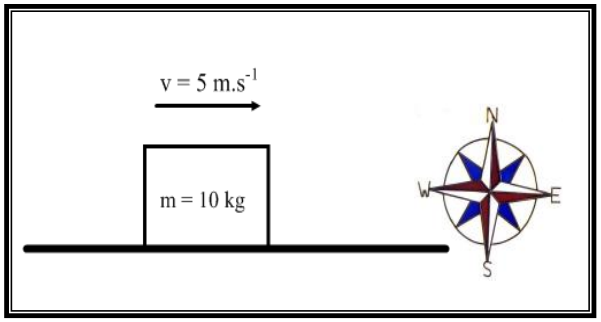
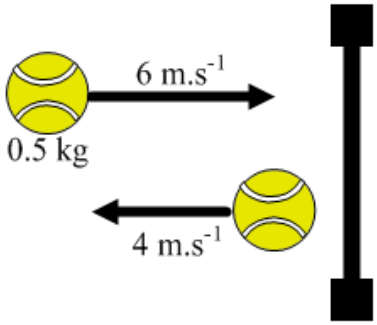
SUBJECT and GRADE	Physical Sciences Grade 12	
TERM 1	*Week 1*	
TOPIC	Momentum as a vector quantity.	
AIMS OF LESSONS	At the end of the lesson you should be able to: Define momentum. Calculate the momentum of an object in motion or at rest. Write newton's second law in terms of momentum. Deal with the information in the follow up lesson on momentum.	
RESOURCES	**Paper based resources** • ***Your text books*** • ***Notebook and drawing equipment***	**Digital resources** Refer to the relevant digital resources: • www.wcedeportal.co.za • Hey Science App for Physical Sciences • Past NSC Examination Question papers • You Tube videos
INTRODUCTION	Write the following definitions from your textbooks: Define momentum. Definition of Impulse Principle of conservation of linear momentum Definition of an elastic collision Definition of an inelastic collision Newton's Second law in terms of change in momentum Newton's Third Law of motion	

CONCEPTS AND SKILLS	**Momentum is defined as the product of the mass and velocity of an object**. p - momentum m – mass v – velocity p = mv Example: An object, mass 10 kg, moves with a constant velocity of 5 $m.s^{-1}$ due east as shown in the sketch below.  The momentum of the object is calculated as follows. P = mv = 10 x 5 = 50 kg.m.s^{-1} east NOTE: Momentum is a vector quantity and the direction must be indicated. **<u>Change in momentum (Δp) and impulse (FΔt).</u>** When the velocity or direction of motion of an object changes, the momentum also changes. We calculate the change in momentum (Δp) by subtracting the object's initial momentum from its final momentum. Read up what "Δ" and "Δp" means.

Example: A ball, mass 0.5 kg, initially moves to the right at 6 $m.s^{-1}$ and bounces against a vertical wall. The ball leaves the wall with a velocity of 4 $m.s^{-1}$as indicated in the sketch. Ignore the effects of gravity on the ball. Calculate the change in momentum of the ball.



Here you should use the sign convention. Stating which direction is positive and which is negative.
Choosing towards the right (towards the wall) as positive, the solution is as follows:

$\Delta p = p_f - p_i$

$= mv_f - mv_i$

$= 0{,}5(-4-6)$

$= -5\ kg.m.s^{-1}$

The chance in momentum is 5 $kg.m.s^{-1}$ to the left or (away from the wall)

The change in momentum is equal to the impulse of the object.

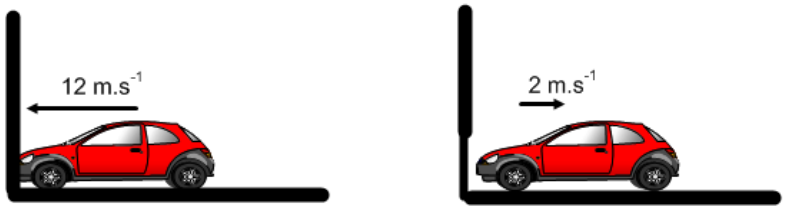
Impulse is defined as the product of the force and contact time of the force.

If the above collision of the ball with the wall lasts 0.1 s, then we can calculate the force that the wall exerts on the ball as follows:

$F_{nett}\Delta t = \Delta p$ .....(1)

$F_{nett} \times 0.1 = -5$

$F_{nett} = -50\ N$ (ie 50 N to the left or away from the wall.

	Rearranging equation 1 we get: $F_{net} = \frac{\Delta P}{\Delta t}$ … (2) Derive $F_{net} = ma$ from (2). Show the relationship between: F_{net} and a (m constant) F_{net} and Δp for uniform acceleration (t and m are constant) in horizontal and vertical motion. This new equation defines Newton's Second Law and explains why modern cars have multiple crumple zones as a safety feature. The crumple zones increase the impact time during a collision and ensure reduced forces acting on the occupants of the car State Newton's second law in terms of momentum: **The net force acting on an object is equal to the rate of change of momentum.**
ACTIVITIES/ ASSESSMENT	**ACTIVITY 1.1** 1 Air bags can reduce serious injury during vehicle accidents 1.1Use Physics principles to explain how air bags can reduce serious injury during collisions. (3) 1.2 In a crash test, a car of mass 1.2×10^3 kg collides with a wall and rebounds as illustrated below. The initial and final velocities of the car are 12 m·s^{-1} to the left and 2 m·s^{-1} to the right respectively. The collision lasts 0.1 s. 

	Calculate the: 1.2.1 Impulse of the car during the accident (4) 1.2.2 Average force exerted on the car (3) 1.3 How will the magnitude of the force exerted on the car be affected if the time interval of the collision remains 0,1 s, but the car does not bounce off the wall? Write down only INCREASES, DECREASES or REMAINS THE SAME. Explain your answer.
CONSOLIDATION	**Do questions 9;10;11 and 12 on pages 3 and 4 in The Answer Series (2 in 1)** **The follow up lesson will deal with the conservation of momentum.**
VALUES	The application of certain rules in order to get to an outcome. Safety during collisions based on scientific principles.