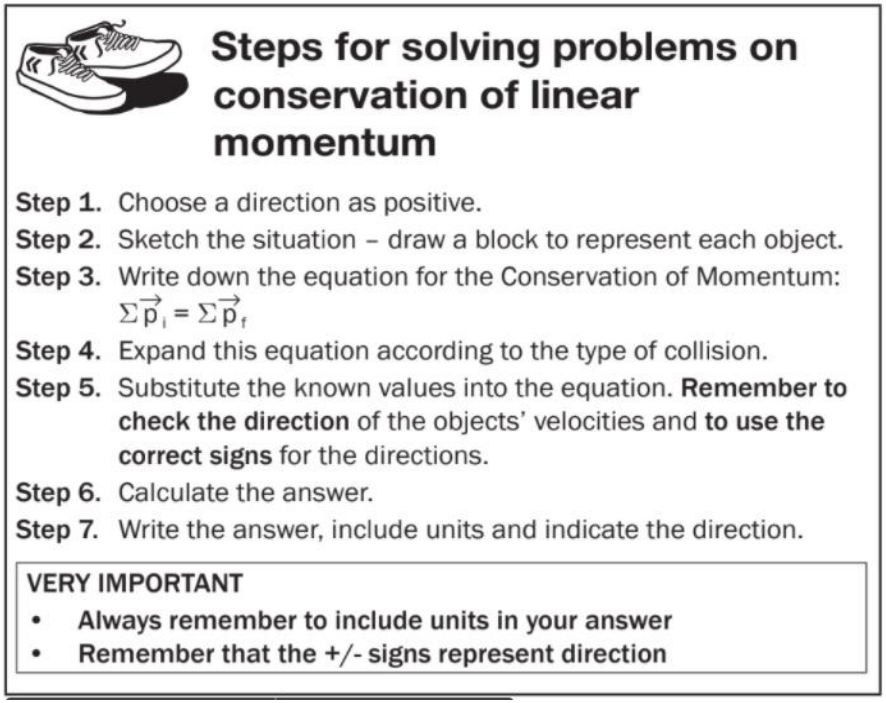
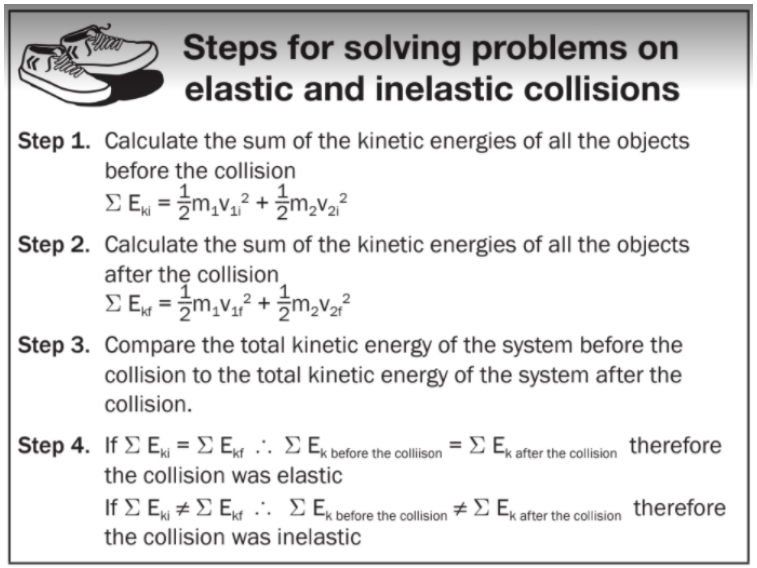
SUBJECT and GRADE	Physical Sciences Grade 12	
TERM 1	*Week 3*	
TOPIC	Conservation of Momentum (in one dimension)	
AIMS OF LESSON	At the end of the lesson you should be able to: • Apply conservation of momentum to collisions of two objects (one dimension). • Distinguish between elastic and inelastic collisions by calculation.	
RESOURCES	***Paper based resources:*** *• Your text books* *• Mind the Gap (p. 40-49)*	***Digital resources:*** *Refer to the relevant digital resources:* • *WCED Lesson plan, Week1 https://drive.google.com/file/d/1vmRX-SzjSyi71Wg-8vLAB9a2VdulPtqv/view?usp=sharing* • *Mind the gap textbook: (p. 40-49) https://drive.google.com/file/d/1umhFy4qgE2b-HUmu3GyeEyidJWHQ12F7/view?usp=sharing* • *Science Clinic textbook link: (p.17 & 18) https://drive.google.com/file/d/0B4GLHicOS92UUHlQVk5yZWRqbDQ/view?usp=sharing* • *Gr 12 Physics workbook: (p. 28 – 47) https://drive.google.com/file/d/1--q43rYHR2XxTfNVSkV8C-6xm1XiQbfZ/view?usp=sharing* • *Gr 12 Physics workbook teacher's guide (p. 30 – 47). https://drive.google.com/file/d/1xpgfUcJO94JqMi6wPhY5CLZSWDlpAlnJ/view?usp=sharing*
INTRODUCTION	• *Revise the WCED lessons for Term1, Weeks 1 & 2.* • *Ensure that you know and understand the following definitions and laws:*	

	MECHANICS: MOMENTUM AND IMPULSE	
	Contact forces	Contact forces arise from the physical contact between two objects (e.g. a soccer player kicking a ball.)
	Non-contact forces	Non-contact forces arise even if two objects do not touch each other (e.g. the force of attraction of the earth on a parachutist even when the earth is not in direct contact with the parachutist.)
	Momentum	Linear momentum is the product of an object's mass and its velocity. In symbols: $p = mv$ Unit: N·s or kg·m·s^{-1}
	Newton's Second Law of motion in terms of momentum	The net (or resultant) force acting on an object is equal to the rate of change of momentum of the object in the direction of the net force. In symbols: $F_{net} = \frac{\Delta p}{\Delta t}$
	Principle of conservation of linear momentum	The TOTAL linear momentum in an isolated system remains constant (is conserved). In symbols: $\Sigma p_{before} = \Sigma p_{after}$
	Closed system	A system in which the net external force acting on the system is zero.
	Impulse	The product of the resultant/net force acting on an object and the time the resultant/net force acts on the object. In symbols: Impulse = $F_{net}\Delta t$ Unit: N·s or kg·m·s^{-1}
	Impulse-momentum theorem	In symbols: $F_{net}\Delta t = m\Delta v = m(v_f - v_i)$ Unit: N·s or kg·m·s^{-1}
	Elastic collision	A collision in which both total momentum and total kinetic energy are conserved.
	Inelastic collision	A collision during which kinetic energy is not conserved.
CONCEPTS AND SKILLS	**Conservation of momentum and elastic and inelastic collisions** • Explain what is meant by a closed/an isolated system (in Physics), i.e. a system on which the resultant/net external force is zero. A closed/an isolated system excludes external forces that originate outside the colliding bodies, e.g. friction. Only internal forces, e.g. contact forces between the colliding objects, are considered.	

	• State the principle of conservation of linear momentum: The total linear momentum of a closed system remains constant (is conserved). • Apply the conservation of momentum to the collision of two objects moving in one dimension (along a straight line) with the aid of an appropriate sign convention. Work through the worked examples of the 5 problem types (Activities 3 to 7) that you should be able to solve on p. 40 – 45 in the Mind the Gap textbook. • *Mind the gap textbook: (p. 40-45)* *https://drive.google.com/file/d/1umhFy4qgE2b-HUmu3GyeEyidJWHQ12F7/view?usp=sharing*  **Steps for solving problems on conservation of linear momentum** **Step 1.** Choose a direction as positive. **Step 2.** Sketch the situation – draw a block to represent each object. **Step 3.** Write down the equation for the Conservation of Momentum: $\Sigma\vec{p}_i = \Sigma\vec{p}_f$ **Step 4.** Expand this equation according to the type of collision. **Step 5.** Substitute the known values into the equation. **Remember to check the direction** of the objects' velocities and **to use the correct signs** for the directions. **Step 6.** Calculate the answer. **Step 7.** Write the answer, include units and indicate the direction. **VERY IMPORTANT** • **Always remember to include units in your answer** • **Remember that the +/- signs represent direction** • Distinguish between elastic collisions and inelastic collisions by calculation. Work through the worked examples (Activities 8 & 9) that you should be able to solve on p. 46 – 49 in the Mind the Gap textbook. *Mind the gap textbook: (p. 46-49)*

	https://drive.google.com/file/d/1umhFy4qgE2b-HUmu3GyeEyidJWHQ12F7/view?usp=sharing  **Steps for solving problems on elastic and inelastic collisions** **Step 1.** Calculate the sum of the kinetic energies of all the objects before the collision $\Sigma E_{ki} = \frac{1}{2}m_1v_{1i}^2 + \frac{1}{2}m_2v_{2i}^2$ **Step 2.** Calculate the sum of the kinetic energies of all the objects after the collision $\Sigma E_{kf} = \frac{1}{2}m_1v_{1f}^2 + \frac{1}{2}m_2v_{2f}^2$ **Step 3.** Compare the total kinetic energy of the system before the collision to the total kinetic energy of the system after the collision. **Step 4.** If $\Sigma E_{ki} = \Sigma E_{kf}$ $\therefore$ $\Sigma E_{k\ before\ the\ colliison} = \Sigma E_{k\ after\ the\ collision}$ therefore the collision was elastic If $\Sigma E_{ki} \neq \Sigma E_{kf}$ $\therefore$ $\Sigma E_{k\ before\ the\ collision} \neq \Sigma E_{k\ after\ the\ collision}$ therefore the collision was inelastic
ACTIVITIES/ASSESSMENT	*Work through the worked examples on p. 17 & 18 of the Science Clinic textbook via the following link:* *https://drive.google.com/file/d/0B4GLHicOS92UUHlQVk5yZWRqbDQ/view?usp=sharing*
CONSOLIDATION	*Work through the examination questions in the Gr 12 Physics workbook: (p. 28 – 47)* *https://drive.google.com/file/d/1--q43rYHR2XxTfNVSkV8C-6xm1XiQbfZ/view?usp=sharing* *The answer to the questions above is in the teacher's guide (p. 30 – 47). Attempt to solve the problems before you have a look at the answers:* *https://drive.google.com/file/d/1xpgfUcJO94JqMi6wPhY5CLZSWDlpAlnJ/view?usp=sharing*
VALUES	*Any moving body has momentum. This property (momentum) will cause you to slide in the direction of your motion after you have fallen to the ground.*