GRADE	10	SUBJECT	Physical Sciences	WEEK	23	TOPIC	Reactions in aqueous solutions - Ions in aqueous solution: their interaction and effects – Time: 60 min	Lesson	1

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	

LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Explain how water dissolves ionic solids by using diagrams and referring to the polar nature of water molecules. • Represent the dissolution process with balanced chemical equations. • Use the abbreviations (s) and (aq) in balanced equations. • Investigate different types of solutions (experiments) and write balanced ionic equations for the reactions.

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:
Question and answer, Explanation, Practical activity (experiment)

2. LESSON DEVELOPMENT

2.1. Introduction [5 min]

• Educator introduces the lesson with a practical demonstration, e.g.: Fill two beakers with water. Add a few iodine crystals (or any other insoluble solid to the water in beaker A and a few crystals of a soluble solid (sodium chloride) to beaker B.

• Ask learners to explain why NaCl(s) is soluble in water and I_2(s) not.

• Mention the rule that solutes dissolve in solvents when the intermolecular forces are of the same strength. Do not discuss different intermolecular forces in depth

PRE-KNOWLEDGE
A basic understanding of the following:

• Atoms, molecules and ionic compounds.

• Electronegativity and polar molecules.

• Solutions as homogeneous mixtures.

BASELINE ASSESSMENT

Design a worksheet to test pre-knowledge. (Hand out at the commencement of the lesson) **[10 min]**

QUESTIONS for the BASELINE ASSESSMENT

1. Define electronegativity.

2. Give formulas for the following compounds:

2.1 Potassium permanganate

2.2 Sodium hydroxide

2.3 Potassium nitrate

2.4 Sodium chloride

3. Atoms combine to form compounds. Name the type of atoms that are found in

3.1 Molecular compounds

3.2 Ionic compounds

4. Give an example of a homogeneous solution.

ANSWERS for the BASELINE ASSESSMENT

1. Electronegativity is a measure of the tendency of an atom to attract electrons towards it self.

2.

2.1 $KMnO_4$

2.2 NaOH

2.3 KNO_3

2.4 NaCl

Non metal atoms

2.5 Metal and non metal atoms

5. NaCl(s) in $H_2O(\ell)$

• Educator provides answers to the baseline assessment and allows learners to do self assessment.

2.2. Main Body (Lesson presentation) [20 min]

• Educator uses an appropriate model (ball-and-stick, or space-filling) to explain the bended (angular shape) of the water molecule.

• The oxygen atom shares one pair of electrons with each hydrogen atom to form two covalent bonds. There are two lone pairs of electrons on the O-atom, which repels the bond pairs to such an extend that the water molecule has a bended shape with an angle of $104{,}5^0$ between the H-atoms.

• The electronegativity of oxygen is 3,5 and hydrogen is 2,1. The shared electron pair in each covalent bond of the water molecule is closer to the O-atom than to the H-atom.

• The O-atom has a partial negative charge (δ^-) and each H-atom has a partial positive charge (δ^+).

• A water molecule is therefore **polar,** has a net **dipole moment** and is a good solvent for polar and ionic solids.

• Educator can demonstrate the polar nature of water molecules by doing the following demonstration:

- Use a small piece of charged plastic.
- Bring it close to a streamlet of water.
- Observe and explain why the water is attracted to the plastic: The polar water molecules rotate and charged particles in the plastic attract like charges in the water.

• Educator explains that the process of dissolving solids in water as:

(a) a process where an ionic substance breaks up into ions.
(b) a covalent compound forms ions.

• Learners should understand that the dissolution process implies that electrostatic forces must be broken between ions – energy is needed for this process. New bonds must be formed between ions and polar molecules – energy is released during this process. If the energy released is equal to or more than the energy absorbed, the solid will dissolve in the water.

• The process where ions are surrounded by polar water molecules, are called **hydration**.
• Learners must be able to define dissolution and hydration.

(a) **Dissolution** (dissolving) is the process where ionic crystals break up into ions in water.
(b) **Hydration** is the process where ions become surrounded with water molecules.

• Use the diagram to explain how polar water molecules attract the positive and negative ions during the process of dissociation.

• Educator explains how balanced chemical equations are used to represent the dissolution process.

Note that the solid is indicated by (s) and hydrated ions are indicated with (aq) derived from aqua or water. The symbol (ℓ) is used for pure liquids.

$NaCl(s) \xrightarrow{H_2O} Na^+(aq) + Cl^{-+}(aq)$

$Mg(NO_3)_2(s) \xrightarrow{H_2O} Mg^{2+}(aq) + 2NO_3^-(aq)$

$CuSO_4(s) \xrightarrow{H_2O} Cu^{2+}(aq) + SO_4^{2-}(aq)$

LEARNER ACTIVITY [20 min]

EXPERIMENT

• Learners work in small groups.

• Each group prepare one of the following solutions: sodium chloride in water; potassium permanganate in water; sodium hydroxide in water; potassium nitrate in water.

• Learners have to write down their observations.

QUESTIONS for the PRACTICAL ATIVITY

1. Write balanced equations for the formation of each solution.
2. Mention one exothermic and one endothermic dissolution process.
3. Give the common name for sodium hydroxide and potassium hydroxide.

ANSWERS for the PRACTICAL ACTIVITY

1. $NaCl(s) \xrightarrow{H_2O} Na^+(aq) + Cl^{-+}(aq)$
$KMnO_4(s) \xrightarrow{H_2O} K^+(aq) + MnO_4^-(aq)$
$NaOH(s) \xrightarrow{H_2O} Na^+(aq) + OH^-(aq)$

$KNO_3(s) \xrightarrow{H_2O} K^+(aq) = NO_3^-(aq)$

2. Exothermic: $NaOH(s)$ in $H_2O(\ell)$ – the temperature increases
   Endothermic: $KNO_3(s)$ in $H_2O(\ell)$ – temperature decreases
3. Sodium Hydroxide – caustic soda
   Potassium Hydroxide –caustic potash

3. Conclusion [5 min]

• Educator discusses the answers of the experiment. Write the equations on the chalk board. Ensure that learners use the correct formulae (including capital letters) and that all the phases are indicated in the equation.
• Educator summarises important aspects of the lesson, reinforcing what needs to be remembered and recalled.

HOMEWORK QUESTIONS/ ACTIVITY Educator give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook e.g. Physical Science written by volunteers (Siyavula) Exercise 18.1 pg 312 (30 min)
Resources: Relevant models to explain the shape and polarity of the water molecule, Apparatus to do the experiment, worksheets, power point presentation, transparency; prescribed text books, CAPS-document (page 46).

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	23	TOPIC	Reactions in aqueous solutions - Ions in aqueous solution: their interaction and effects – Time: 60 min	Lesson	2

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	**At the end of the lesson learners should be able to:** • Define the process of dissolving (solid ionic crystal breaking up into ions in water) • Define the process of hydration (ions are surrounded by water molecules in water solution)		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Question and answer, Explanation, diagrams on chalk board or power point presentation

2. LESSON DEVELOPMENT

2.1 Introduction and Baseline assessment. [10 min]

• Educator mark homework assignment.

• Learners do corrections and clarify misconceptions.

PRE-KNOWLEDGE

A basic understanding of the following:

• Angular shape and polar nature of the water molecule.
• Meaning of the symbols (s), (aq) and (ℓ).
• Writing balanced equations for different dissolution processes.

2.2 (Main Body (Lesson presentation) [40 min]

• Educator explains that the process of dissolving solids in water as:

(a) a process where an ionic substance breaks up into ions – dissociation. (See diagram). Ask learners to suggest a method to reverse the process of dissolving sodium chloride – by evaporating the water.
(b) a process where a covalent compound forms ions – ionisation.

• **Ionisation**: Polar covalent molecules do not contain ions. When these solids dissolve in water, the molecules are ionised (ions are formed during the process).

$HCl(g) + H_2O(\ell) \longrightarrow H_3O^+(aq) + Cl^-(aq)$

• Use the diagram to explain how hydronium and chloride ions are formed during the process of ionisation.

• Acids like hydrochloric acid, sulphuric acid, nitric acid and acetic acid will form ions when they are dissolved in water.

• Ammonia (a base) will also form ions in water.
• Mention the importance of the dissolution process: if water was not able to dissolve different substances, life on earth would not be possible.
• Educator may discuss a few important dissolution processes in daily life. Explain the positive and negative impact – e.g. in rivers and oceans the dissolved oxygen allow fish and other organisms to breathe. Acid rain and “hard water” are negative results of the dissolution process.
• **Hard water** is water that has high mineral content (in contrast with “soft water”). Hard water is generally not harmful to one's health, but can pose serious problems in industrial

settings, where water hardness is monitored to avoid costly breakdowns in boilers, cooling, and other equipment that handles water. In domestic settings, hard water is often indicated by a lack of suds formation when soap is agitated in water. Wherever water hardness is a concern, water softening is commonly used to reduce hard water's adverse effects.

Hard water contains a great amount of Ca^{2+} and Mg^{2+} ions and prevents soap from foaming.

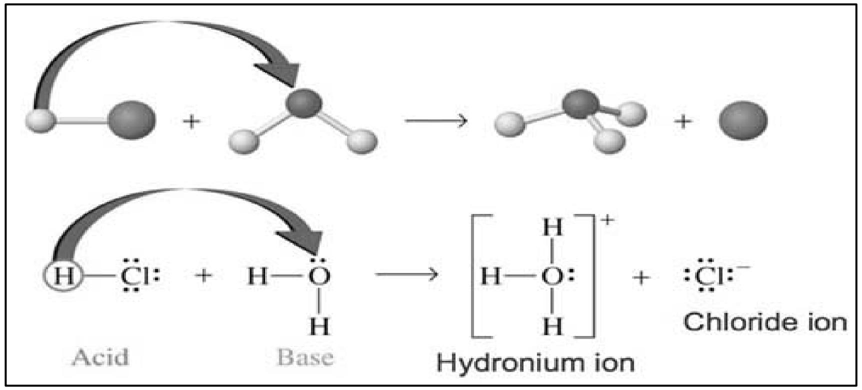
• The process of ion exchange can be used to prevent the effects of hard water. The Ca^{2} and Mg^{2+} ions are replaced by Na^{+} - ions.

3. CONCLUSION [10 min]

• Educator summarises important aspects of the lesson, reinforcing what needs to be remembered and recalled.

• Allow learners to start with the homework activity.

HOMEWORK QUESTIONS/ ACTIVITY [30 min]



1. Define the following:

1.1 Dissociation
1.2 Dissolution

1.3 Hydration

2 Classify the following substances as ionic or molecular.

2.1 Potassium chloride (KCl)

2.2 Ethanol (CH_3CH_2OH)

2.3 Sugar ($C_{12}H_{22}O_{11}$)

2.4 Lithium bromide (LiBr)

3 Write the formulas for the ions present in aqueous solutions of the following salts without writing the complete reaction.

3.1 $AlCl_3$

3.2 $CaSO_4$

3.3 $Mg(NO_3)_2$

4

4.1 What is “hard” water?

4.2 Name ONE disadvantage of “hard” water

4.3 Give ONE advantage and ONE disadvantage of soft water.

5

5.1 What is acid rain?

5.2 Name three gases that are responsible for acid rain.

5.3 Name TWO disadvantages of acid rain.

ANSWERS:HOMEWORK ACTIVITY

1

1.1 The process where an ionic substance breaks up into ions.

1.2 The process during which a substance dissolves in water to form an aqueous solution.
1.3 The process where ions become surrounded with polar water molecules.

2
2.1 Ionic
2.2 Molecular
2.3 Molecular

2. 4 Ionic

3

3.1 Al^{3+}; Cl^{-}

3.2 Ca^{2+}; SO_4^{2-}

3.3 Mg^{2+}; NO_3^{-}

4

4.1 It is water that contains high concentrations of minerals such as Ca^{2} and Mg^{2+} caused by contact with rocks and sediments.

4.2 It forms precipitations when the metal ion reacts with soap in the water; prevents soap from foaming; damages geysers and water pipes.

4.3 Soap foams in soft water; it tastes salty.

5

5.1 Acid rain forms when CO_2(g), SO_2(g) and NO_2(g) dissolves in rain water.

5.2 Carbon dioxide; sulphur dioxide and nitrogen dioxide

5.3 Acid rain damages buildings and plants.

HOMEWORK QUESTIONS/ ACTIVITY Educator give learners the homework activity or any other appropriate exercise from a prescribed text book. Learners can do an **informal research** task or poster to explain the effects of hard water or acid rain.
Resources: Diagrams to explain dissociation and ionisation, worksheets, power point presentation, transparency; prescribed text books, CAPS-document (page 46).

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	24	TOPIC	Reactions in aqueous solutions – Electrolytes and extent of ionization as measured by conductivity – Time: 60 min	Lesson	1

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	**At the end of the lesson learners should be able to:** • Describe a simple circuit to measure conductivity of solutions. • Relate conductivity to concentration of ions in solution and solubility of particular substances. • Understand that conductivity will not always be a measure of solubility.		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Question and answer, Explanation, Experiment

2. LESSON DEVELOPMENT

2.1. Introduction and Baseline assessment. [10 min]

• Educator mark homework assignment.

• Learners do corrections and clarify misconceptions.

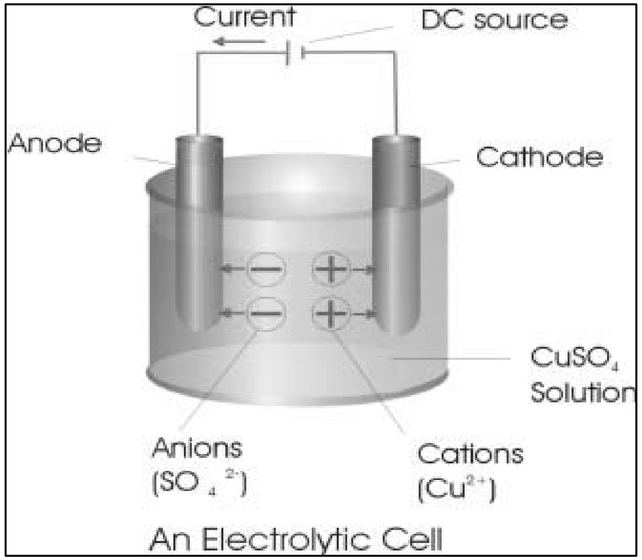
PRE-KNOWLEDGE

A basic understanding of the following:

• The difference between ionic and molecular substances.

• Writing balanced equations for different dissolution processes (dissociation and ionisation).

• Understand the basic principles of flow of electric current in a closed circuit.



2.2 Main Body (Lesson presentation) [20 min]

• Educator explains the difference between metal conductors and solutions that conduct electricity.

(a) Metals conduct electricity because they contain free, delocalized electrons and positive ions that can act as charge carriers.
(b) In aqueous solutions, the charge carriers are the ions formed during the dissolution process.
(c) A solution that contains ions is called an electrolyte.
(d) The process of conducting electricity through an ionic solution is called electrolysis.

• Educator can use the diagram to explain how negative ions (SO_4^{2-+}(aq)) are attracted to the anode of the electrolytic cell. Negative ions are called anions.

• The positive ions (Cu^{2+}) move towards the cathode and are called cations.

• A strong electrolytic solution contains a great amount of ions per volume and the concentration of ions is high. The result is that the electrolytic solution will be a good conductor of electricity.

• In weak electrolytic solutions, the concentration of ions is low and the aqueous solution can be considered as a weak conductor of electricity.

• Conductivity of an aqueous solution depends on three factors:

(a) The nature of the substance
(b) The solubility of the substance
(c) the concentration of ions in the solution

• Aqueous solutions of all ionic substances will be good conductors of electricity and strong electrolytes.

• A few molecular substances will ionise in water to form strong electrolytes e.g. strong acids like HCl; H_2SO_4 and HNO_3. Strong acids ionise completely and form many ions in an aqueous solution.

• Most molecular substances will form weak electrolytes e.g. weak acids like CH_3COOH and H_2CO_3 or not be electrolytes like alcohol and aqueous solutions of sugar. Weak acids ionise incompletely and form only a few ions in an aqueous solution. Non polar compounds do not ionise in water and no ions are formed.

• Pure water is a molecular substance and cannot conduct electricity – it contains no ions that can act as carriers of charge.

2.3 LEARNER ACTIVITY [25 minutes]

EXPERIMENT

Schools may have apparatus that are specially designed for this experiment, but if it is not available carbon rods can be used as conductors. Use a glass beaker for the different aqueous solutions and connectors to connect the rods to a power supply or battery and sensitive ammeter with a globe (if available)

A. **Aim: To investigate the conductivity of different pure substances and aqueous solutions**

• Test small amounts of NaCl(s), $CaCl_2$(s) and NH_4Cl (s) for electric conductivity.

• Repeat the test, but use distilled water and tap water.

• Dissolve sodium chloride in distilled water and test for conductivity.

• Repeat with aqueous solutions of $CaCl_2$, NH_4Cl, HCl, CH_3COOH, C_2H_5OH and $C_{12}H_{22}O_{11}$.

• Tabulate the results. Indicate the following: no conductivity; weak conductors; good conductors very good conductors.

•Rinse the electrodes between every investigation.

B. **Aim: To determine the relation between the concentration of ions in a solution and the electric conductivity.**

• Dissolve a teaspoon full of sodium chloride in 50 cm^3 of distilled water,

• Use a medicine dropper and drop 1 drop of this solution in a glass beaker half filled with distilled water.

• Use carbon rods as electrodes and connect with connectors to a battery and ammeter. Note the reading on the ammeter.

• Add another drop of NaCl(aq) and note the reading on the ammeter again.

• Repeat the process eight times.

QUESTIONS FOR PRACTICAL ACTIVITY

1. Classify the substances used in experiment A as molecular or ionic.
2. Why is it important to rinse the electrodes between the investigations?
3. Explain why the solid compounds did not conduct electricity.
4. Write balanced chemical equations for the good conductors.
5. List the solutions that do not conduct electricity and explain the observation.
6. What happens to the reading on the ammeter if the concentration of the sodium chloride solution is increased? Explain the observation.
7. Name two other factors, apart from concentration, that can influence the electric conductivity of a solution.

ANSWERS: PRACTICAL ACTIVITY

1 Ionic; $NaCl$, $CaCl_2$, NH_4Cl

2 To prevent one solution to become contaminated with another – it has to be a fair test.

3 The ions in a solid compound are bonded with strong electrostatic forces. The ions cannot move and cannot act as charge carriers.

4

4.1 $NaCl(s) \xrightarrow{H_2O} Na^+(aq) + Cl^{-+}(aq)$

4.2 $CaCl_2(s) \xrightarrow{H_2O} Ca^{2+}(aq) + 2Cl^-(aq)$

4.3 $NH_4Cl(s) \xrightarrow{H_2O} NH_4^+(aq) + Cl^{-+}(aq)$

4.4 $HCl(g) + H_2O(\ell) \longrightarrow H_3O^+(aq) + Cl^-(aq)$

5 CH_3COOH, C_2H_5OH and $C_{12}H_{22}O_{11}$ There are no ions in the solutions to act as charge carriers.

6 The reading on the ammeter increases – the solution becomes more concentrated – more ions per volume water.

7 The nature of the substances, the solubility of the substance in water.

3. Conclusion [5 min]

• Educator discusses the answers of experimental questions..

• Summarises important aspects of the lesson, reinforcing what needs to be remembered and recalled.

HOMEWORK QUESTIONS/ ACTIVITY Learners have to study the content of lesson 1 – 3. They will write an informal test at the start of the next lesson.

Resources: Apparatus to do the experiment, worksheets, power point presentation, transparency; prescribed text books, CAPS-document (page 46).

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	24	TOPIC	Reactions in aqueous solutions: Precipitation reactions	Lesson	2

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	

LESSON OBJECTIVES	**At the end of the lesson learners should be able to:** • Classify precipitation reactions as ion exchange reactions • Write balanced reaction equations to describe precipitation of insoluble salts.

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Question and answer, explanation, experiment

2. LESSON DEVELOPMENT

2.1 Baseline assessment. [10 min]

- Learners write a short test (informal assessment) on content of lesson 1, 2 and 3.

- Educator can set questions from activities or use questions from prescribed text books, or use the questions below. [20 marks].

QUESTIONS FOR INFORMAL ASSESSMENT

1. Polar molecules ionise in aqueous solutions. Write the correct equation to represent the ionization of ethanoic acid (CH_3COOH) (3)

2. Define the process of hydration. (2)

1.
(a) Explain the meaning of the word electrolyte. (2)
(b) Classify the following substances as electrolytes when they are in aqueous solutions.

(i) Ammonia
(ii) Magnesium sulphate
(iii) Sulphuric acid
(iv) Sugar ($C_{12}H_{22}O_{11}$) (4)
2.

(a) How will you distinguish between an ionic substance and a molecular substance? (4)

(b) Write a balanced chemical equation to show how ammonium sulphate dissociates in water. (5)

ASWERS FOR INFORMAL TEST

1. $CH_3COOH(\ell) + H_2O(\ell)$ √ $\longrightarrow CH_3COO^-(aq)$√ + $H_3O^+(aq)$ √ (3)

2. Where ions become surrounded with water molecules in a water solution. √√ (2)

3.

(a) An electrolyte is an aqueous solution that contains ions√ and can conduct electricity√. (2)

(b)

(i) Electrolyte √

(ii) Electrolyte √

(iii) Electrolyte √

(iv) No electrolyte √ (4)

1.

(a) Ionic substances consist of metal and non metal elements. √√

Molecular substances consist of non metal elements only.√√ (4)

(b) $(NH_4)_2SO_4(s)$√√ $\xrightarrow{H_2O}$ √$2NH_4^+(aq)$√ + $SO_4^{2-}(aq)$√ (5)

2.2 Introduction [5 min]

- Educator introduces the lesson with a practical demonstration to investigate the reaction of ions in a solution.
  - Prepare two aqueous solutions of potassium iodide (KI(aq)) and lead(II)nitrate ($Pb(NO_3)_2(aq)$).
  - Note the colour of the solutions.
  - Mix equal volumes of the solutions in a clean beaker.
  - Allow learners to observe any changes in the beaker.

PRE-KNOWLEDGE

A basic understanding of the following:

- Writing balanced equations for different dissolution processes.

Main Body (Lesson presentation) [40 min]

- Educator uses the observation of the experiment to explain the concept precipitate.
- A precipitate is the insoluble substance that forms during a reaction between ions in an aqueous solution.
- During a precipitation reaction, positive ions exchange their negative ions to form an insoluble salt.
- Discuss some of the well-known precipitates like $CaSO_4$ (plaster of Paris) or $MgSO_4$ that is used as a purgative.
- Explain the process of ion exchange in any suitable manner, e.g.

- Dissociation reaction of KI(s) in water: $KI(s) \xrightarrow{H_2O} K^+(aq) + I^-(aq)$ (1)
- Dissociation of $Pb(NO_3)_2(s)$ in water: $Pb(NO_3)_2\,(s) \xrightarrow{H_2O} Pb^{2+}(aq) + 2NO_3^-(aq)$ (2)
- Balance equation (1) to obtain the correct amount of positive and negative ions in the solution:

  $2KI(s) \xrightarrow{H_2O} 2K^+(aq) + 2I^-(aq)$

- $2K^+(aq) + 2NO_3^-(aq) + Pb^{2+}(aq) + 2I^-(aq) \longrightarrow 2K^+(aq) + NO_3^-(aq) + PbI_2(s)$ (3)

• Equation (3) represents the reaction in ionic form.

• K^+ and NO_3^- appear on both sides of the arrow and are called the spectator ions. Spectator ions are not included in the netto ionic equation.

• Only the reactants that is responsible for the formation of the precipitate appears in the net ionic reaction:

$Pb^{2+}(aq) + 2I^-(aq) \longrightarrow PbI(s)$

• Educator now discusses the general rules for the solubility of salts.

Anion	Soluble Cation	Insoluble cation
Nitrate (NO_3^-)	All ions	-
Chloride (Cl^-)	Most ions	Ag^+, Hg^+, Pb^{2+}
Bromides (Br^-)	Most ions	Ag^+, Hg^+, Pb^{2+}
Iodides (I^-)	Most ions	Ag^+, Hg^+, Pb^{2+}
Sulphate (SO_4^{2-})	Most ions	Ca^{2+}, Sr^{2+}, Ba^{2+}, Ag^+, Pb^{2+}
Carbonate (CO_3^{2-})	Li^+, Na^+, K^+, NH_4^+	Most ions
Hydroxide ($OH^{-+)}$)	Li^+, Na^+, K^+, NH_4^+, Ca^{2+}, Sr^2, Ba^{2+}	Most ions
Sulphide (S^2)	Li^+, Na^+, K^+, NH_4^+	Most ions

• Allow learners to do another example in class e.g. write:

(a) molecular equations

(b) ionic equations and

(c) net ionic equations for the reaction between aqueous solutions of magnesium sulphate and barium chloride.

Answer:

(a) $MgSO_4(aq) + BaCl_2(aq) \longrightarrow MgCl_2(aq) + BaSO_4(s)$

(b) $Mg^{2+}(aq) + SO_4^{2-}(aq) + Ba^{2+}(aq) + 2Cl^{-}(aq) \longrightarrow Mg^{2+}(aq) + 2Cl^{-}(aq) + BaSO_4(s)$

(c) $Ba^{2+}(aq) + SO_4^{2-}(aq) \longrightarrow BaSO_4(s)$

3. Conclusion [5 min]

- Educator summarises important aspects of the lesson, reinforcing what needs to be remembered and recalled.
- It is important that learners know the solubility rules

HOMEWORK QUESTIONS/ ACTIVITY Educator give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook e.g. Physical Science written by volunteers (Siyavula) Exercise 18.2 pg 319 (30 min)
Resources: Worksheets, power point presentation, transparency; prescribed text books, CAPS-document (page 48).

Reflection/Notes:

Name of Teacher:		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	24	TOPIC	Reactions in aqueous solutions: Precipitation reactions	Lesson	3

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	**At the end of the lesson learners should be able to:** • Write balanced reaction equations to describe precipitation of insoluble salts. (Molecular, ionic and net ionic) • Explain how to test for the presence of the following ions in a solution: chloride, bromide, iodide, sulphate, carbonate		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Question and answer, explanation, experiment

2. LESSON DEVELOPMENT

Pre-knowledge

A basic understanding of the following:

- Ion exchange
- Precipitation reactions
- The difference between molecular ionic and net ionic equations
- The solubility table

2.1 Baseline assessment. [10 min]

- Learners mark the homework assignment.
- Educator test learners pre-knowledge during the marking process.

2.2 Introduction [5 min]

- Educator explains the test to distinguish between halides by using a silver nitrate solution.
- In the second test learners have to distinguish between carbonates and sulphates.
- Divide the learners into small groups and provide each group with a copy of the method to save time.

2.3 Main Body (Lesson presentation) [30 min]

LEARNER ACTIVITY - EXPERIMENT

Experiment A:

Aim: To test for halides

- Learners will need solutions of sodium chloride, sodium bromide, sodium iodide and silver nitrate, as well as concentrated nitric acid and ammonia solution.

- Fill three different test tubes with the halide solutions and add a few drops of silver nitrate into each by using a medicine dropper.
- Note the colour of any precipitation that is formed.
- Add a few drops of concentrated nitric acid. Wait a few seconds and add a few drops of ammonia solution.
- Write down the observation.

Experiment A:

Aim: To distinguish between sulphate and carbonate solutions.

- Learners will need solutions of magnesium sulphate and sodium carbonate in separate test tubes.
- Add a few drops of barium chloride to the solution in each test tube.
- Write down the observations.
- Add a few drops of concentrated nitric acid to each test tube.
- Write down the observations.

QUESTIONS for the PRACTICAL ATIVITY

1. Write down the formulae and colours of the different precipitates that form during the experiment.
2. Identify the precipitates that are soluble in concentrated nitric acid and dilute ammonia solution.
3. Write the net ionic equation for each of the precipitation reactions.

ANSWERS for the PRACTICAL ACTIVITY

1. Silver chloride - AgCl(s) – white precipitate

   Silver bromide – AgBr(s) – light beige precipitate

   Silver iodide – AgI(s) – yellow precipitate

   Barium sulphate – $BaSO_4$(s) – white precipitate

   Barium carbonate – $BaCO_3$(s) – white precipitate

2. Barium carbonate is soluble in $HNO_3(\ell)$

   AgCl(s), AgBr(s) and AgI(s) are soluble in NH_3(aq)

3 $Ag^{+}(aq) + Cl^{-}(aq) \longrightarrow AgCl(s)$

$Ag^{+}(aq) + Br^{-}(aq) \longrightarrow AgBr(s)$

$Ag^{+}(aq) + I^{-}(aq) \longrightarrow AgI(s)$

$Ba^{2+}(aq) + SO_4^{2-}(aq) \longrightarrow BaSO_4(s)$

$Ba^{2+}(aq) + CO_3^{2-}(aq) \longrightarrow BaCO_3(aq)$

2.4 Conclusion [5 min]

- Educator discusses the answers for the PRACTICAL ACTIVITY.
- Educator summarises important aspects of the lesson, reinforcing what needs to be remembered and recalled

HOMEWORK ACTIVITY

1. A precipitation reaction is an example of an ion exchange reaction. Explain the meaning of ion exchange.

2.
(a) What is a precipitation reaction?
(b) What is the driving force behind a precipitation reaction?

3.
(a) What is a halide?

(b) Describe a test that you can do in the laboratory to distinguish between sodium chloride, sodium bromide and sodium iodide.

4. The equations of four chemical reactions are given below:

(i) $BaCl_2 + Na_2SO_4 \longrightarrow BaSO_4 + 2NaCl$

(ii) $AgNO_3 + NaCl \longrightarrow AgCl + NaNO_3$

(iii) $CuSO_4 + 2NaOH \longrightarrow Cu(OH)_2 + Na_2SO_4$

(iv) $Pb(NO_3)_2 + CaCl_2 \longrightarrow PbCl_2 + Ca(NO_3)_2$

Answer the following questions:

(a) Give the formulae and names of the precipitates that are formed in the reactions mentioned.

(b) Write the ionic reactions for equation (I) and (II).

(c) Write the net ionic reactions for equation (III) and (IV)

ANSWERS FOR HOMEWORK ACTIVITY

1. It is the type of reaction where the positive ions exchange their respective negative ions due to a driving force.
2.

(a) Precipitation reactions are ion exchange reactions during which an insoluble solid is formed.

(b) Formation of an insoluble solid.

3.

(a) Ions formed when halogen atoms gain electrons.

(b) Add a few drops of silver nitrate solution ($AgNO_3(aq)$) to each test tube.

A white precipitate indicates that the solution contains Cl^- ions.

A beige precipitate indicates that the solution contains Br^- ions

A yellow precipitate indicates that the solution contains I^- ions

4.

(a) (I) Barium sulphate $BaSO_4(s)$

(II) Silver chloride $AgCl(s)$

(III) Sodium sulphate $Na_2SO_4(aq)$

(IV) Lead chloride $PbCl_2(s)$

(a) (I) $Ba^{2+}(aq) + 2Cl^-(aq) + 2Na^+(aq) + SO_4^{2-}(aq) \xrightarrow{H_2O} BaSO_4(s) + 2Na^+(aq) + 2Cl^-(aq)$

(II) $Ag^+(aq) + NO_3^-(aq) + Na^+(aq) + Cl^-(aq) \xrightarrow{H_2O} AgCl(s) + Na^+(aq) + NO_3^-(aq)$

(b) (III) $2Na^+(aq) + SO_4^{2-}(aq) \xrightarrow{H_2O} Na_2SO_4(s)$

(IV) $Pb^{2+}(aq) + 2Cl^-(aq) \xrightarrow{H_2O} PbCl_2(s)$

HOMEWORK QUESTIONS/ ACTIVITY Learners do the homework activity or any other exercise from a prescribed text book [30 min]
Resources: Chemicals and apparatus to do the experiment, chalk board, worksheets, power point presentation, transparency; prescribed text book; CAPS-document (page 48).

Reflection/Notes:

Name of Teacher		HOD:	
Sign:		Sign:	
Date:		Date:	

GRADE	10	SUBJECT	Physical Sciences	WEEK	24	TOPIC	Reactions in aqueous solutions: Precipitation reactions - Time: 60 min.	Lesson	4

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	**At the end of the lesson learners should be able to:** • Identify an ion or ions in a solution from a description of the reactants mixed and the observations of the products. • Prepare a salt from its soluble reagents.		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Question and answer, explanation, experiment

2. LESSON DEVELOPMENT

Pre-knowledge

A basic understanding of the following:

• Precipitation reactions being a process of ion exchange

• The solubility table

2.1. Baseline assessment. [15 min]

• Learners mark the homework assignment.

• Educator addresses any miss conceptions.

• Educator test learners pre-knowledge during the marking process through questions and answers.

2.2 Introduction [5 min]

• Educator explains to learners that a saltcan be prepared by using an ion exchange reaction.

• In the practical activity that follows, learners will prepare copper(II)carbonate from its soluble reagents

2.3 Main Body (Lesson presentation)[30 min]

LEARNER ACTIVITY - EXPERIMENT

Aim: To prepare copper(II)carbonate

• Dissolve approximately 9 g of copper sulphate in 50 cm^3 distilled water.

• Dissolve approximately 10 g of sodium carbonate in 50 cm^3 distilled water.

• Mix the two solutions and write down your observations.

• Use a funnel and filter paper to filter separate the solution and the precipitate.

• Dry the precipitate in a small container with a Bunsen burner.

Copper (II) carbonate

QUESTIONS for the PRACTICAL ATIVITY

1 Describe the physical appearance of the $CuCO_3$ crystals.

2 Write equations to represent the dissociation reactions of $CuSO_4$(s) and Na_2CO_3(s).

3 Write an ionic equation to represent the reaction that takes place when the two solutions are mixed.

4 Identify the spectator ions in the filtrate.

ANSWERS for the PRACTICAL ACTIVITY

1 The crystals have a green-blue colour.

2 $CuSO_4(s) \xrightarrow{H_2O} Cu^{2+}(aq) + SO_4^{2-}(aq)$

$Na_2CO_3(s) \xrightarrow{H_2O} 2Na^+(aq) + CO_3^{2-}(aq)$

3. $Cu^{2+}(aq) + SO_4^{2-}(aq) + 2Na^+(aq) + CO_3^{2-}(aq) \xrightarrow{H_2O} 2Na^+(aq) + SO_4^{2-}(aq) + CuCO_3(s)$

4. $Na^+(aq)$ and $SO_4^{2-+}(aq)$

Silver bromide – AgBr(s) – light beige precipitate

2.4 Conclusion[10 min]

- Educator discusses the answers for the PRACTICAL ACTIVITY.
- Educator summarises important aspects of the lesson, reinforcing what needs to be remembered and recalled

HOMEWORK QUESTIONS/ ACTIVITY Educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook. Use Physical Science written by Volunteers –Siyavula, End of chapter exercise p 324 no. Q 6. [30 min]

Resources: Chemicals and apparatus for experiment, chalk board, power point presentation, transparency; prescribed text book; CAPS-document (page 48).

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	25	TOPIC	Reactions in aqueous solutions: other chemical reaction types, in water solutions. - Time: 60 min.	Lesson	1

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	**At the end of the lesson learners should be able to:** • Identify precipitation reactions, gas formation reactions and acid-base reactions as ion exchange reactions.. • Define redox reactions as electron transfer reactions.		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

; **Question and answer, explanation**.

2. LESSON DEVELOPMENT

Pre-knowledge

A basic understanding of the following:

- Ion exchange reactions – precipitation reactions have been discussed in lessons 4 – 6.

2.1. Baseline assessment. [5 min]

- Educator test learners pre-knowledge through questions and answers.

2.2 Introduction [5 min]

- Educator explains that a precipitate is not the only product that can be formed during ion exchange reaction.
- Do simple demonstrations to introduce

(a) the formation of a gas e.g. add 10 ml of a 0,1 $mol \cdot dm^{-3}$ HCl(aq) to zinc powder. Bring a burning splinter close to the mouth of the test tube and allow learners to hear the popping sound.

(b) the effect of acids and bases on indicators e.g. extract juice from red cabbage. Add a few ml to two different test tubes. Add a few drops of HCl(aq) to the one test tube and NaOH(aq) to the other. The colour of the juice becomes redder in the presence of the acid and more yellow in the presence of the base.

2.3 Main Body (Lesson presentation)[40 min]

- Educator explains that the gas formed during a reaction depends on the reactants that are used.
- Learners must be familiar with general reactions for gas formation:
  - metal + acid ⟶ salt + hydrogen gas
  - metal carbonate + acid ⟶ salt + water + carbon dioxide
  - $2CuO(s) \xrightarrow{\Delta} 2Cu(s) + O_2(g)$

- Ask learners to write molecular and ionic equations for the following reactions:

(a) Magnesium and sulphuric acid

$Mg(s) + H_2SO_4(aq) \longrightarrow MgSO_4(aq) + H_2(g)$

$Mg^{2+}(aq) + 2H^+(aq) + SO_4^{2-}(aq) \longrightarrow Mg^{2+}(aq) + SO_4^{2-}(aq) + H_2(g)$

(b) Calcium carbonate and nitric acid

$CaCO_3(s) + HNO_3(aq) \longrightarrow Ca(NO_3)_2(aq) + H_2O(\ell) + CO_2(g)$

- Educator refers to the reactions above and explain the tests for $H_2(g)$, $CO_2(g)$ and $O_2(g)$

(a) $H_2(g)$: The gas explodes with a popping sound if a burning wooden splinter is brought to the mouth of the test tube.

(b) $CO_2(g)$: Clear limewater (saturated $Ca(OH)_2(aq)$) becomes milky (turbid) in the presence of $CO_2(g)$. It might be interesting to classify this reaction as a precipitation reaction: $Ca(OH)_2(aq) + CO_2(g) \longrightarrow CaCO_3(s) + H_2O(\ell)$.

(c) $O_2(g)$: A glowing wooden splinter lights in the presence of $O_2(g)$.

- The driving force for the reactions mentioned above is gas formation.
- Educator discusses a few well known acids and bases, gives their formulae and uses.
- A base that is soluble in water is called an alkali.
- The reaction between an acid and a base is called neutralisation: acid + base ⟶ salt + water. Not all neutralisation reactions produce a neutral solution. If a strong acid reacts with a weak base an aqueous solution of the salt will be acidic. If I weak acid reacts with a strong base an aqueous solution of the base will be basic.
- The driving force behind acid-base reactions is proton transfer e.g. Hydrochloric acid + sodium hydroxide:
- Molecular equation: $HCl(aq) + NaOH(aq) \longrightarrow NaCl(aq) + H_2)(\ell$
- Ionic equation : $H^+(aq) + Cl^-(aq) + Na^+(aq) + OH^-(aq) \longrightarrow Na^+(aq) + Cl^-(aq) + H_2O(\ell)$
  net ionic equation: $H^+(aq) + OH^-(aq) \longrightarrow H_2O(\ell)$
- Redox reactions take place when electrons are transferred. Reactions in batteries, processes like respiration and reactions of fuels are redox reactions.
- The process of electron transfer implies to half reactions: oxidation, during which electrons are donated and reduction, during which electrons are gained.
- The following are examples of redox reactions:

➢ Displacement of a metal from an ionic solution by a more reactive metal is and example of a redox reaction.

$Zn(s) + CuSO_4(aq) \longrightarrow ZnSO_4(aq) + Cu(s)$

➢ Displacement of hydrogen:

$2Na(s) + H_2O(\ell) \longrightarrow 2NaOH(aq) + H_2(g)$

$Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + H_2(g)$

- Displacement of one halogen from its compound by a more reactive halogen.

  $Cl_2(g) + 2KBr(aq) \longrightarrow Br_2(g) + 2KCl(aq)$

  Note that the reactivity of metal in crease from top to bottom in group 1, 2 and 3 – refer to the reactivity series of metals.

  The reactivity of the halogens decrease from top to bottom in group 17 (VII).

- Educator can demonstrate the displacement reaction between Zn(s) and $CuSO_4(aq)$.

3. Conclusion[10 min]

- Educator summarises important aspects of the lesson, reinforcing what needs to be remembered and recalled.
- Use the question and answer method to ensure that learners understand all concepts.

HOMEWORK QUESTIONS/ ACTIVITY

Lesson 8 will mostly consist of practical work. Learners will conduct an experiment of which the marks will be used for informal assessment.

Educator hand out the practical task. Learners have to do preparation for the experiment and study the content of the previous 7 lessons to ensure that they know and understand the topic: reactions in aqueous solutions.[30 min]

Resources: Worksheets that have been done, prescribed text books and any other relevant material. CAPS-document (page 49).

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	25	TOPIC	Reactions in aqueous solutions: Other chemical reaction types in water solutions	Lesson	2

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	**At the end of the lesson learners should be able to:** • Identify chemical reactions types experimentally. • Understand the driving force between the different reaction types. • Identify each reaction type in a group of miscellaneous chemical reactions experimentally.		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

; **Question and answer, explanation**.

2. LESSON DEVELOPMENT

Pre-knowledge

A basic understanding of the following:

- The difference between the following reaction types: precipitation, gas formation, proton transfer and electron transfer.
- Molecular, ionic and net ionic equations for all the reactions mentioned.
- The aim and method of the experiment that will be conducted.

2.1. <u>Baseline assessment. [5 min]</u>

- Educator test learners pre-knowledge by using the question and answer method.
- Discuss problems and eliminate misunderstandings.

2.2 <u>Introduction [5 min]</u>

- Educator explains the procedure that learners have to follow while conducting the experiment.

➢ Learners have to do six different experiments to identify them as one of the following:

(a) precipitation reaction

(b) gas forming reaction

(c) acid-base reaction

(d) redox reaction

➢ Learners work in small groups (the number of learners in each group will depend on the availability of chemicals and apparatus).

➢ Each group conduct all the experiments.

- Learners answer the questions on the worksheet individually.

2.3 Main Body[20 min]

LEARNER ACTIVITY: CONDUCTING AN EXPERIMENT

Apparatus: Distilled water, spatula, measuring cylinders, 6 test tubes, 2 beakers, bowl with water, Bunsen burner, lighter, medicine dropper and a balloon.

Chemicals: Potassium bromide, silver nitrate solution, magnesium carbonate, diluted hydrochloric acid, manganese (IV)oxide, a piece of sodium metal (the size of a pea), zinc powder, copper(II)sulphate solution, diluted nitric acid, diluted sodium hydroxide and blue litmus paper.

Method A: Mix two $cm^3$of KBr(aq) and 2 cm^3 of $AgNO_3$(aq) in a clean test tube. Write down the observations.

Method B: Add a spatula of $MgCO_3$(s) to 10 cm^3HCl(aq) in a clean test tube. Write down the observations.

Method C: Use a spatula to add MnO_2(s) to a test tube. Cover the mouth of the test tube with the balloon. Light the Bunsen burner and carefully heat the content of the test tube. Write down the observation.

Method D: Drop the small piece of sodium into the bowl of water. Write down the observations. Don't touch the sodium with you bare hands.

Method E: Fill a clean test tube with 5 cm^3 of $CuSO_4$(aq). Add a small amount of Zn(s) to the content of the test tube. Write down the observations.

Method F: Add 5 $cm^3$$HNO_3$(aq) to a clean test tube. Test the solution with blue litmus paper. Write down the observation. Add 5 cm^3 of NaOH(aq) to the same test tube. Test the content of the test tube with the same litmus paper. Write down the observation.

LEARNER ACTIVITY: WORKSHEET.[25 min]

1. Write down the aim of the practical activity. (2)

2. Give the observation of each of the experiments. (12)

3. Write down the molecular equation for each of the reactions. (12)

4. Classify each reaction as one of the following: precipitation reaction, gas formation reaction, acid-base reaction or redox reaction.(9) **TOTAL: 35]**

ANSWERS OF WORKSHEET

1. Identify the following chemical reaction types experimentally: precipitation, gas forming, acid-base and redox reactions.√√

2. A. A Beige precipitate forms.√√

B. Bubbles form in the test tube. Gas formation. √√

C. The balloon is blown up – a gas is formed.√√

D. The sodium melts and makes a sizzling sound. Gas is formed.√√

E. The zinc metal seems to be dissolving, the blue colour of the solution disappears and reddish-brown copper is formed.√√

F. The Litmus turns red in the nitric acid.√It turns blue again after NaOH(aq) is added to the nitric acid.√

1. A. $KBr(aq) + AgNO_3(aq) \rightarrow AgBr(s) + KNO_3(aq)$ √√

   B. $MgCO_3(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(\ell) + CO_2(g)$ √√

   C. $MnO_2(s) \rightarrow O_2(g) + Mn(s)$ √√

   D $Na(s) + H_2O(\ell) \rightarrow NaOH(aq) + H_2(g)$ √√

   E. $Zn(s) + CuSO_4(aq) \rightarrow Cu(s) + ZnSO_4(aq)$ √√

   F. $HNO_3(aq) + NaOH(aq) \rightarrow NaNO_3(aq) + H_2O(\ell)$ √√

2. A. Precipitation reaction √

   B. Gas forming and Redox reaction √√

   C. Gas forming and redox reaction √√

   D. Gas forming and redox reaction √√

   E. Redox reaction √

   F. Acid Base reaction (Neutralization) √

2.4 Conclusion[5 min]

- Educator summarises important aspects of the lesson, reinforcing what needs to be remembered and recalled.
- Ask questions and interact with learners to clear any misunderstandings.

HOMEWORK QUESTIONS/ ACTIVITY Educator gives a revision worksheet to test learner's strengths and weaknesses concerning the topic: reactions in aqueous solution. Use Physical Science written by Volunteers –Siyavula, End of chapter exercise p 324 no. 1 - 5. [30 min]

Resources: Laboratory equipment, chemicals, PowerPoint presentation, transparencies, chalk board, prescribed text book; CAPS-document (page 48).

Reflection/notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	25	TOPIC	Quantitative aspects of chemical change: Atomic mass and the mole concept. - Time: 60min.	Lesson	3

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	

LESSON OBJECTIVES	**At the end of the lesson learners should be able to:** • Describe the mole as SI unit for the amount of substance • Relate amount of substance to relative atomic mass • Describe the relationship between mole and Avogadro's number • Conceptualize the magnitude of Avogadro's number using appropriate analogies • Write Avogadro's number with all the zeros to get a better concept of the amount • Define molar mass • Describe the relationship between molar mass and relative molecular mass and relative formula mass • Calculate the molar mass of a substance

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Question and answer, Explanation,

2. LESSON DEVELOPMENT

2.1. Introduction [5 min]

• Educator introduces the lesson with an explanation of the need for a unit that can be used to count the amount of substance used in a chemical reaction.

• Although atoms ions and molecules are extremely small, the work of a chemist requires quantitative analysis – he must be able to do accurate calculations by using the unit.

• **Mole** is the SI-unit for the amount of substance.

• Amedeo Avogadro mentioned the possibility of the number in 1811, but the value of the number was determined only after his death.

PRE-KNOWLEDGE

A basic understanding of the following:

• Formulae of atoms, molecules and ionic compounds.

• The difference between ONE atom, ONE molecule and ONE formula unit.

• Atomic mass and relative atomic mass.

• The different functions of a scientific calculator.

BASELINE ASSESSMENT[5 min]

- Educator asks learners to discuss the difference between an atom, a molecule and a formula unit and clarify misconceptions.

• Write formulae on the chalk board and allow learners to classify the particles as atoms, molecules and formula units e.g.

Mg	Atom	Element
H_2SO_4	Molecule	Compound (non-metals)
NaCl	Formula unit	Compound (Metal and non metals)
Si	Atom	Element
$C_{12}H_{22}O_{11}$	Molecule	Compound (Non-metals)
$FeCl_3$	Formula unit	Compound (Metal and non-metals)

2.2. Main Body (Lesson presentation) [30 min]

• Educator explains the molar concept and describes the mole as the SI-unit for amount of substance. (SI is the acronym for Système International d'Unités)

• Definition: One mole is the amount of substance that has the same number of particle (atoms, ions, molecules or formula units) as 12 g of the $^{12}_{6}C$ –isotope.

•The value of this number can be determined by using electrolysis.

• The name of the number: Avogadro's number

• The magnitude of the number 602 213 000 000 000 000 000 000 = 602 213 x a million x a million x a million = **$6,02 \times 10^{23}$**

• Educator can use a few examples of molar quantities to give learners a better idea of the magnitude of the number on the one hand and the extremely small size of atoms, molecules, ions and formula units on the other hand e.g.

- If Avogadro's number is grains of sand which is spread out evenly across the State of California, The layer of sand will be as high as a 10 story building.
- If Avogadro's number is marshmallows packed across the 50 States of America the layer will be 965 km high.

•Other numbers that are used to count: (learners may be more familiar with these numbers) are

- 1 dozen – 12
- 1 gross – 144
- 1 million – 1 000 000
- 1 kilo – 1 000

• If the learners understand the need for Avogadro's number Educator can explain the relation between

- Atomic mass and relative atomic mass
- Molar mass and relative molar mass
- Formula mass and relative formula mass

• The relative mass compares the mass of the specific particle to the mass of one $^{12}_{6}C$ –isotope. Relative masses are numbers only and do not have a SI-unit e.g. A_r(Mg) = 24; M_r(NaCl) = (23+35,5 = 58,5)

• Atomic mass, molar mass and formula mass is the mass of one mole ($6,02 \times 10^{23}$) particles. If the relative mass of a particle is taken as the mass in gram, the amount can be considered as one mole of the substance.

NB. Elements consist of atoms. Mention the elements that exist as diatomic molecule: H_2, N_2, O_2, F_2, Cl_2, Br_2 and I_2.

Covalent bonds between non-metal atoms form molecules.

Ionic bonds between metal and non-metal atoms form formula units that consist of ions.

Formula units can contain water of crystallization because ions in the unit attract polar molecules from the atmosphere e.g. $CoCl_2 \bullet 6H_2O$ – Molar mass = (59 + 2(35,5) + 6(2 + 16))

• Educator can discuss the following examples with the learners:

Substance	Number of moles	Relative mass	Mass in gram	Particles	Number of particles
Carbon	1	12	12	Atoms	$6,02 \times 10^{23}$
Ammonia	1	17	17	Molecules	$6,02 \times 10^{23}$
Sodium bromide	1	103	103	Formula units	$6,02 \times 10^{23}$
Aluminium	1	27	27	Atoms	$6,02 \times 10^{23}$
Copper sulphate	1	144	144	Formula units	$6,02 \times 10^{23}$
Nitric acid	1	63	63	Molecules	$6,02 \times 10^{23}$

Learners Activity [10 min]

CLASS WORK ACTIVITY(Peer assessment)

Educator allows learners to do the activity in class.

1. Give the relative atomic mass of each of the following:

(a) Potassium

(b) Nitrogen

(c) Phosphorous

1. Calculate the molecular masses of:

(a) Bromine

(b) Sulphuric acid

(c) ammonia

2. Calculate the formula masses of:

(a) Iron(ii)chloride

(b) Lithium oxide

(c) silver nitrate

(d) Barium sulphate

(e) $CuSO_4 \cdot 5H_2O$

2. Determine the **number of particles** in each of the following quantities. State the type of particles present.

(a) 2 mole calcium

(b) 36 g water

(c) 3 mole magnesium iodide

ANSWERS TO CLASSWORK ACTIVITY

1.

(a) K - 40

(b) N - 14

(c) P - 31

2.

(a) Br_2 – 2(80) = 160

(b) H_2SO_4 – 2(1) + 32 + 4(16) = 98

(c) NH_3 – 14 + 3(1) = 17

3.

(a) $FeCl_2$ – 56 + 2(35,5) = 126

(b) Li_2O – 2(7) + 16 = 30

(c) $AgNO_3$ – 108 + 14 +3(16) = 170

(d) $BaSO_4$ – 137 + 32+ 4(16) = 217

(e) $CuSO_4 \cdot 5H_2O$ – 64 + 32 + 4(16) + 5(18) = 250

4.

(a) 2 x 6,02 x 10^{23} = 1,204 x 10^{24} Ca-atoms

(b) M(H_2O) = 2(1) + 16 = 18 g·mole (the mass of one mole of water molecules is 18 g). 36/18 = 2 therefore the number of molecules is 2 x 6,02 x 10^{23} = 1,204 x 10^{24} H_2O molecules.

(c) 3 x 6,02 x 10^{23} = 1,806 x 10^{24} MgI_2 formula units.

3. <u>Conclusion [10 min]</u>

- Educator discusses the answers of the classwork activity.
- Educator summarises important aspects of the lesson, reinforcing what needs to be remembered and recalled

HOMEWORK QUESTIONS/ ACTIVITY Educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook. Use Physical Science written by Volunteers – Siyavula, Ex 19.1 p 328 and 19.2 p 331 [20 min]
Resources: Scientific calculator, worksheets, power point presentation, transparency; prescribed text book; CAPS-document (page 50).

Reflection/notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	25	TOPIC	Quantitative aspects of chemical change: Atomic mass and the mole concept. – Time: 60 min	Lesson	4

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Reason qualitatively and proportionally the relationship between number of moles, mass and molar mass • Calculate mass, molar mass and number of moles according to the relationship $n = \frac{m}{M}$		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:
Question and answer, Explanation,

2. LESSON DEVELOPMENT

2.1 Introduction [5 min]

- Educator explains the fact that atomic mass, molecular mass and formula mass have the same magnitude as molar mass.
- In this lesson, learners will understand the relationship between the mole, molar mass, molar volume and number of moles.

PRE-KNOWLEDGE

A basic understanding of the following:

- Atomic mass and relative atomic mass.
- The mole concept.
- Avogadro's number.

BASELINE ASSESSMENT[5 min]

Educator asks questions to determine if learners understand the meaning of one mole.

It is also important that they understand why it is important to introduce Avogadro' s number – atoms are so extremely small that it is impossible to do quantitative analyses with single units.

2.2. Main Body (Lesson presentation)_[40 min]

- Educator explains that the amount of substance is not equal to the mass of the substance, although these quantities are proportional.
- The relation between mole, mass and molar mass is given by the following formula:

$n = \frac{m}{M}$

n is the number of moles: SI unit is mole
m is the give/unknown mass: SI unit is gram
M = the molar mass: SI unit is $g{\cdot}mol^{-1}$

- The relation between mole, number of particles and Avogadro's number, is given by the formula:

$n = \frac{\text{number}}{N_A}$

$N_A = 6{,}02 \times 10^{23}$ particles.

- The relation between mole, volume and standard volume for particles in the gas phase is given by the formula:

  $n = \frac{volume}{V_0}$

  V_0 is the volume of the gas at STP (Standard Temperature and Pressure).

  According the Avogadro's Law (1811) equal volumes of all gasses will consist of equal numbers of particles if measured at the same temperature and pressure.

  Standard temperature: 0^0 C

  Standard pressure: 101,3 kPa or 1,01 x 10^5 Pa

  At STP, I mole of all gasses occupy a volume of 22,4 dm^3.

- Educator can do a few examples on the chalk board to ensure that learners know how to manipulate the formulae and how to use the scientific calculator in the correct way

Examples:

1. Determine the number of mole of atoms in 96 g of sulphur.
   M(s) = 32 $g \cdot mol^{-1}$
   $n = \frac{m}{M} = \frac{96}{32}$ = 3 mole S atoms
2. Determine the number of formula units in 2,3 mole of sodium chloride
   $n = \frac{number}{N_A}$
   $number = nN_A$ = (2,3)(6,02 x 10^{23})
   number = 1,38 x 10^{24} formula units (Remember that ionic substances consist of formula units)

3. Determine the number of particles in 10 g sulphur(IV)oxide.
   $M(SO_2)$ = 32 + (2)(16) = 64 $g \cdot mol^{-1}$
   $n = \frac{m}{M}$ $\frac{10}{64}$ = 0,16 mole SO_2 molecules
   $n = \frac{number}{N_A}$
   number = nN_A = (0,16)(6,02 x 10^{23})
   9,63 x 10^{22} SO_2 molecules
4. It is found that a balloon contains 4 g of oxygen gas at STP. Calculate

(a) Determine the volume of the oxygen in the balloon at STP.
   $M(O_2)$ = 32 $g \cdot mol^{-1}$
   $n = \frac{m}{M} = \frac{4}{32}$ = 0,125 mole $O_2(g)$

   $n = \frac{volume}{V_0}$
   volume = nV_0
   volume = (0,125)(22,4)
   volume = 2,8 dm^3

(b) Determine the number of oxygen molecules in the balloon.
   $n = \frac{number}{N_A}$
   number = nN_A
   number = (0,125)(6,02 x 10^{23})
   number = 7,53 x 10^{22} O_2 molecules

(c) Calculate the number of oxygen atoms in the balloon.
Ratio of O_2 molecules: O atoms is1:2
The number of atoms in the balloon is therefore (2)(7,53 x 10^{22})
Number of atoms = 1,51 x 10^{23}

- If necessary Educator can choose more examples from prescribed text books to allow learners to gain more confidence.

3. Conclusion [10 min]

- Educator summarises important aspects of the lesson, reinforcing what needs to be remembered and recalled

HOMEWORK QUESTIONS/ ACTIVITY Educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook. Use Physical Science written by Volunteers – Siyavula, Ex 19.3 p 333 and 19.4 p 336 [20 min]
Resources: Scientific calculator, worksheets, power point presentation, transparency; prescribed text book; CAPS-document (page 50).

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	26	TOPIC	Quantitative aspects of chemical change: Molecular and formula masses	Lesson	1

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	**At the end of the lesson learners should be able to:** • Determine the empirical formula for a given substance from percentage composition. • Determine the number of moles of water of crystallization in salts.		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Question and answer, Explanation, Experiment

2. LESSON DEVELOPMENT

2.1 Introduction [5 min]

- Educator explains that the symbol and formula of a compound is important in quantitative calculations.
- A chemist sometimes has to determine the formula by using the masses of the atoms in the compound or the percentage mass of each element in the compound.

PRE-KNOWLEDGE

A basic understanding of the following:

- Atomic mass, molecular mass and formula mass.
- The Avogadro constant: the number of units represented by one mole of a substance – $6{,}02 \times 10^{23}$
- Meaning of the concept percentage.

BASELINE ASSESSMENT[15 min]

- Educator mark homework activity.
- Allow time for learners to ask questions and clear any misconceptions.

2.2. Main Body (Lesson presentation) [15 min]

- Educator explains the difference between empirical and molecular formulae.
- The **empirical formula** of a substance indicates the simplest whole number ration of the atoms in the compound.
- **Molecular formula** indicates the real number of atoms in the compound - note
- Educator uses the following (or any other) example to explain the method.

When mercury reacts with chlorine it is discovered that the compound contains 73,9% mercury (Hg atoms) and 26,1% chlorine (Cl atoms) determine the empirical formula of the compound.

Answer (Use the steps below as a guideline)

(a) If the mass of the sample is 100 g, it contains 73,9 g Hg atoms and 26,1 g Cl atoms.

(b) Convert the masses in (a) to mole

Hg: $n = \frac{m}{M} = \frac{73,9}{201}$ = 0,369 mole Hg atoms

Cl: $n = \frac{m}{M} = \frac{26,1}{35,5}$ = 0,735 mole Cl atoms

(c) Divide the smallest number of moles in the other mole numbers: $\frac{0.369}{0.369}$ = 1 and $\frac{0,735}{0,369}$ = 2

(d) The ratio between the atoms in the compound is: Hg:Cl = 1:2

(e) Empirical formula = **$HgCl_2$**

- The second part of this lesson is a practical activity. To save time the Educator can demonstrate this experiment

<u>Demonstration</u> **<u>[20 min]</u>**

- You will need: hydrated copper(II)sulphate crystals, mass meter, small crucible, spatula, Bunsen burner and lighter, tripod stand and metal gauze.
- Determine and note the mass of the crucible.
- Add 4 spatulas of $CuSO_4 \cdot 5H_2O$(s) to the crucible and determine and note the new mass.
- Heat the crucible on the tripod stand until the crystal are white – all the water has evaporated,
- Allow the crucible to cool down. Determine the mass of the crucible and anhydrous (without water) crystals. Note the mass.
- Determine the mass of the water and the $CuSO_4$ crystals.
- Calculate the empirical formula of the $CusO_4$ hydrate.

CALCULATE THE EMPIRICAL FORMULA:

- Determine the number of moles of water: Use the formula $n = \frac{m}{M}$
- Determine the number of moles of $CuSO_4$(s) Use the formula: $n = \frac{m}{M}$
- Determine the water-salt ration: $n(H_2O):n(CuSO_4) = \frac{n(H_2O)}{n(CuSO_4)}$ (The number of moles of water of crystallization) must be a whole number)
- Write the correct empirical formula.

<u>3. Conclusion [5 min]</u>

- Educator summarises important aspects of the lesson, reinforcing what needs to be remembered and recalled

HOMEWORK QUESTIONS/ Use Physical Science written by Volunteers – Siyavula, Ex 19.5 p 344 [30 min]
Resources: Scientific calculator, worksheets, power point presentation, transparency; prescribed text book; CAPS-document (page 51)

Reflection/Notes:

Name of Teacher:		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	26	TOPIC	Quantitative aspects of chemical change: Determining the composition of substances	Lesson	2

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	**At the end of the lesson learners should be able to:** • Determine the percentage composition of an element in a compound.		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Question and answer, Explanation, Classwork activity

2. LESSON DEVELOPMENT

2.1. Introduction [5 min]

- Educator explains that the percentage composition of a compound can be determined if the empirical or molecular formula is known,

PRE-KNOWLEDGE

basic understanding of the following:

- Empirical formulae
- Molecular formulae
- Atomic Mass

BASELINE ASSESSMENT[5 min]

- Educator mark homework activity.
- Allow time for learners to ask questions and clear any misconceptions.

2.2. Main Body (Lesson presentation) [20 min]

- The term percentage composition refers to the percentage of **elements** present in a compound.
- Educator choose an appropriate example to explain how to calculate the percentage composition e.g.

(a) Determine the percentage composition of potassium permanganate ($KMnO_4$)

➢ Determine the molar mass of the compound: M($KMnO_4$) = 39 + 55 + 4(16) = 158 g·mole^{-1}

➢ %K atoms: $\frac{39}{158}$ x 100 = 24,68%

➢ %Mn atoms: $\frac{55}{158}$ x 100 = 34,81%

NOTE! 24,68% + 34,81% + 40,51% = 100%

- %O atoms: $\frac{64}{158}$ x 100 = 40,51%

(b) Determine the percentage nitrogen in ammonium nitrate.

- $M(NH_4NO_3)$ = 14 + 4(1) + 14 + 3(16) = 80 g·mole^{-1}
- %N atoms: $\frac{28}{80}$ x 100 = 35%

LEARNER ACTIVITY [20 min]
CLASS WORK (Self assessment)

Learners are given time in class to do a mixed activity on empirical formulae and percentage composition.

1. Determine the percentage composition of the following substances:
   (a) Sugar ($C_{12}H_{22}O_{11}$)
   (b) Iron(II)nitrate ($Fe(NO_3)_2$)
   (c) Magnesium sulphate
2. Determine the percentage copper atoms in each of the following compounds
   (a) Copper(II)chloride..
   (b) Copper(II)nitrate
   (c) Copper(II)sulphate

ANSWERS TO CLASSWORK ACTIVITY

1.

(a) $M(C_{12}H_{22}O_{11})$ = 12(12) + 22(1) + 11(16) = 342 g·mol^{-1}

%C-atoms: $\frac{144}{342}$ x 100 = 42,11%

%H – atoms: $\frac{22}{342}$ x 100 = 6,43%

%O – atoms: $\frac{176}{342}$ x 100 = 51,46%

(b) $M(Fe(NO_3)_2)$ = 56 + 2(14) + (2)(3)(16) = 180 g·mol^{-1}

%Fe atoms: $\frac{56}{180}$ x 100 = 31,11%

%N – atoms: $\frac{28}{180}$ x 100 =15,56%

%O – atoms: $\frac{96}{180}$ x 100 = 53,33%

(c) $M(MgSO_4) = 24 + 32 + 4(16) = 120\ g{\cdot}mol^{-1}$

%Mg – atoms: $\frac{24}{120}$ x 100 = 20,00%

%S – atoms: $\frac{32}{120}$ x 100 = 26,67%

%O – atoms: $\frac{64}{120}$ x 100 = 53,33%

(a) $M(CuCl_2) = 63,5 + 2(35,5) = 134,5\ g{\cdot}mol^{-1}$

%Cu – atoms: $\frac{63,5}{134,5}$ x 100 = 42,11%

(b) $M(Cu(NO_3)_2) = 63,5 + 2(14) + (2)(3)(16) = 187,5\ g{\cdot}mol^{-1}$

%Cu – atoms: $\frac{63,5}{187,5}$ x 100 = 33,87%

(c) $M(CuSO_4) = 63,5 + 32 + (4)(16) = 159,5$

%Cu – atoms: $\frac{63,5}{159,5}$ x 100 = 39,81%%

3. Conclusion [10 min]

- Learners mark the class work activity.
- Educator summarises important aspects of the lesson, reinforcing what needs to be remembered and recalled

HOMEWORK QUESTIONS/ ACTIVITY Use Physical Science Platinum – D. Grayson, L.Harris, J. Mackenzie, B. Schreuder, Activity 4 p 189 [20 min]

Resources: Worksheets, power point presentation (if available) chalk- or white board, prescribed text book; CAPS-document (page 51).

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	26	TOPIC	Quantitative aspects of chemical change: Determining the composition of a substances - Time: 60 min.	Lesson	3

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	**At the end of the lesson learners should be able to:** • Define and determine concentration as moles per volume.		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Question and answer, explanation.

2. LESSON DEVELOPMENT

2.1 Introduction [5 min]

- Educator explains that the number of moles of a certain compound per unit volume is considered as the concentration.

PRE-KNOWLEDGE

A basic understanding of the following:

- Molar concept
- Avogadro's number
- Aqueous solutions – an ionic or polar substance dissolved in water

BASELINE ASSESSMENT[5 min]

- Educator asks a few general questions (taken from the informal test) to determine learners level of understanding of the molar concept.

2.2 Main Body (Lesson presentation) [20 min]

- Educator explains the meaning of STP – standard temperature and pressure:
- Standard temperature is 0^0C or 273 Kelvin
- Standard pressure is 1 atmosphere or 101,3 kPa (1,01 x 10 Pa).
- 1 mole of all gases occupies a volume of 22,4 dm^3 at STP.
- According to Avogadro's Law equal volumes of all gases at the same pressure and temperature, will consist of the same number of particles.
- Learners may use the formula $n = \frac{\text{volume}}{V_o}$ V_0 is the volume at STP = 22,4 dm^3

Example

Determine the number of oxygen molecules at STP in a sample of 50 dm^3 of $O_2(g)$

➢ Convert volume $O_2(g)$ to mole: $n = \frac{V}{V_0} = \frac{50}{22,4}$ = 2,23 mole O_2 molecules

➢ Convert mole O_2 molecules to number of particles: $n = \frac{\text{number of particles}}{N_A}$

Number of molecules = (2,23)(6,02 x 10^{23}) = 1,34 x 10^{24} O_2 molecules.

- Educator revises the concept aqueous solution – ionic or polar substances (the solute) dissolve in water (the solvent).
- The concentration of the solution is an indication of the amount of solute per volume solvent.
- The formula that can be used to determine the concentration: $c = \frac{n}{V}$ c: concentration in mol·dm^{-2}; n: mole; V: volume in dm^3
- The formula can also be written as: $c = \frac{m}{MV}$
- Educator explains the importance of the correct SI-units.

1 mm^3 = 10^{-9} dm^3

1 cm^3 = 10^{-6} dm^3

1 dm^3 = 100 cm^3 = 1 litre

LEARNER ACTIVITY [20 min]

CLASS WORK (Self assessment)

- Learners are given time in class to do a class work activity to practise the concepts explained by Educator during the lesson.

1. 4,5 g of sodium hydroxide is dissolved in 3,1 dm^3 of water. Determine the concentration of the solution

2. You are asked to prepare an aqueous solution of potassium permanganate. The volume of the solution needed is 500 cm^3. Determine the mass of solid that has to be dissolved if the concentration of the solution is 0,2 mol·dm^{-3}.

3. 6,7 g of sodium carbonate is dissolved in enough water to prepare 250 cm^3 of a solution.

(a) Give the correct formula for sodium carbonate.

(b) Calculate the concentration of the solution.

(c) Calculate the concentration of sodium ions in the solution.

(d) Calculate the concentration of carbonate ions in the solution.

1. Calculate the mass of $CuSO_4 \cdot 5H_2O$ needed to make 650 cm^3 of a 0,1 mol·dm^{-3} copper sulphate solution.

2. Explaining the meaning of a standard solution.

3. Calculate the number of moles of sodium hydroxide pellets in a 250 cm^3 solution with a concentration of 2,1 mol·dm^{-3}.

ANSWERS TO CLASSWORK ACTIVITY

1. $c = \frac{m}{MV} = \frac{4,5}{(40)(3,1)}$ = 0,036 mol·dm^{-3}

2. M($KMnO_4$) = 158 g·mol^{-1}

   $c = \frac{m}{MV}$

   m = cMV = (0,2)(158)(0,25) = 7,9 g $KMnO_4$(s)

3.

(a) Na_2CO_3

(b) $M(Na_2CO_3) = 2(23) + 12 + 3(16) = 106\ g\cdot mol^{-1}$

(c) $c = \frac{m}{MV} = \frac{6,7}{(106)(0,25)}$ 0,25 $mol\cdot dm^{-3}$

(d) Na_2CO_3: Na^+ ions = 1:2 (In one formula unit Na_2CO_3 particles there are 2 mole Na^+ ions)

$c(Na^{+})$ = 0,25 x 2 = 0,50 $mol\cdot dm^{-3}$

Na_2CO_3:CO_3^{2-} ions = 1:1

$c(CO_3^{2-})$ = 0,25 $mol\cdot dm^{-3}$

4. $M(KMnO_4) = 39 + 55 = 4(16) = 158\ g\cdot mol^{-1}$

$c = \frac{m}{MV}$

m = cMV

m = (0,1)(158)(),65)

m = 10,27 g $KMnO_4(s)$

5. A standard solution has a concentration that is known exactly.

6. $c = \frac{n}{V}$

n = cV

n= (2,1)(0,25)

n = 0,52 mole

3. Conclusion [15 min]

- Learners mark the class work activity.
- Educator summarises important aspects of the lesson, reinforcing what needs to be remembered and recalled

HOMEWORK QUESTIONS/ ACTIVITY Use Physical Science written by Volunteers – Siyavula, Ex 19.6 p 348 [30 min]
Resources: Worksheets, power point presentation (if available) chalk- or white board, prescribed text book; CAPS-document (page 51).

Reflection/Notes:

Name of Teacher		HOD:	
Sign:		Sign:	
Date:		Date:	

GRADE	10	SUBJECT	Physical Sciences	WEEK	27	TOPIC	Quantitative aspects of chemical change: Basic stoichiometric calculations	Lesson	1

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	**At the end of the lesson learners should be able to:** • Calculations based on concentration, mass, moles, molar mass and volume		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Question and answer, explanation.

2. LESSON DEVELOPMENT

2.1. Introduction [5 min]

- Educator explains the meaning of stoichiometry: it involves the calculation of the quantities of reactants and products in chemical reactions.
- Stoichiometry means to measure elements)

PRE-KNOWLEDGE

A basic understanding of the following:

- Molar concept
- Avogadro's number
- Balancing of equations for chemical reactions

BASELINE ASSESSMENT[5 min]

- Educator revises .the meaning of coefficients (numbers written before formulae of substances in a chemical reaction).
- Ask learners to write the reaction between hydrogen gas and nitrogen gas to form ammonia as a balanced chemical equation.

  $3H_2(g) + N_2(g) \longrightarrow 2NH_3(g)$

- Ask learners to explain the LAW of CONSERVATION of MASS by using the equation:

  Total mass od reactants: 3(2(1)) + 2(14) = 34 g

  Total mass of products: 2(14 + 3(1)) = 34 g

  Matter can change form but can not be created or destroyed.

- Learners have to understand that the atoms are also conserved during the reaction.

2.2 Main Body (Lesson presentation) [40 min]

- Educator explains the meaning of mole ratios in balanced chemical reactions.
- Use the following example in the explanation: Propane burns in oxygen to form carbon(IV)oxide and water.

- Balanced chemical equation: $1C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(g)$
- Stoichiometric ratios: 1 : 5 : 3 : 4
- Possible meaning of ratios:

  1 molecule $C_3H_8(g)$ + 5 molecules $O_2(g) \longrightarrow$ 3 molecules $CO_2(g)$ + 4 molecules $H_2O(g)$

  1 mole $C_3H_8(g)$ + 5 mole $O_2(g) \longrightarrow$ 3 mole $CO_2(g)$ + 4 mole $H_2O(g)$

  6×10^{23} molecules $C_3H_8(g)$ + $5(6 \times 10^{23}$ molecules $O_2(g) \longrightarrow 3(6 \times 10^{23})$ molecules $CO_2(g)$ + $4(6 \times 10^{23})$ molecules $H_2O(g)$

  44 g $C_3H_8(g)$ + 160 g $O_2(g) \longrightarrow$ 132 g $CO_2(g)$ + 72 g molecules $H_2O(g)$
- Learners have to understand that the stoichiometric ratio has to be maintained in all reactions regardless of the amount of reactants.
- 0,5 mole $C_3H_8(g)$ + 2,5 mole $O_2(g) \longrightarrow$ 1,5 mole $CO_2(g)$ + 2 mole $H_2O(g)$ (Divide the smallest ratio into the others to obtain: 1 : 5 : 3 : 4

- **Example 1:** Potassium chlorate decomposes into oxygen and potassium chloride.

A. Calculate the mass of oxygen formed if 14,7 g of potassium chlorate is heated.

- **Write the balanced chemical equation**:

  $2KClO_3(s) \longrightarrow 2KCl(s) + 3O_2(g)$
- **Determine the molar masses of the substances involved in the question:**

  $M(KClO_3) = 39 + 35,5 + 3(16) = 122,5\ g\cdot mol^{-1}$

  $M(O_2) = 2(16) = 32\ g\cdot mol^{-1}$
- **Convert all the given quantities (mass, volume or number of particles) to mole**

  $n(KClO_3)$ $n = \frac{m}{M} = \frac{14,7}{122,5}$ = 0,12 mol $KClO_3(s)$ is used in the reaction.
- **Use the stoichiometric ratio:**

$KClO_{3=}$	**O_2**
2	3
0,12	x

$2x = (3)(0,12)$

x = 0,18 mole $O_2(g)$ is produced.

- **Convert mole to gram**

$n = \frac{m}{M}$

$m = nM$

m = (0,18)(32)

m = 5,76 g O_2(g) is produced.

- Educator discusses an example of mass-volume calculations:

A. 50 dm^3 of oxygen is produced at STP. Determine the mass of $KClO_3$(s) needed to complete the reaction.

- **Write the balanced chemical equation:**

  $2KClO_3(s) \longrightarrow 2KCl(s) + 3O_2(g)$

- **Determine the molar masses of the substances involved in the question:**

  M($KClO_3$) = 39 + 35,5 + 3(16) = 122,5 $g \cdot mol^{-1}$

  M(O_2) = 2(16) = 32 $g \cdot mol^{-1}$

- **Convert all the given quantities (mass, volume or number of particles) to mole**
- $n = \frac{V}{V_0} = \frac{50}{22,4}$ = 2,23 mole O_2(g) is produced
-

$KClO_3$=	**O_2**
2	3
x	2,23

3x = (2)(2,23)

x = 1,53 mole $KClO_3$(s) is needed

- **Convert mole to gram**

$n = \frac{m}{M}$

$m = nM$

m = (1,53)(122,5)

m = 187,43 g $KClO_3$(s) is needed

3. Conclusion [10 min]

- Educator summarises important aspects of the lesson, reinforcing what needs to be remembered and recalled

HOMEWORK QUESTIONS/ ACTIVITY Use Physical Science written by Volunteers – Siyavula, Ex 19.7 p 354 [30 min]
Resources: Worksheets, power point presentation (if available) chalk- or white board, prescribed text book; CAPS-document (page 52).

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	27	TOPIC	Quantitative aspects of chemical change: Basic stoichiometric calculations - Time: 60 min	Lesson	2

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	**At the end of the lesson learners should be able to:** • Determine the theoretical yield of a product in a chemical reaction when the reaction is started with a known mass of reactant.		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:
Question and answer, explanation, class work activity

2. LESSON DEVELOPMENT

2.1 Introduction [5 min]

- Educator explains that the amount of product that is formed during chemical reactions is normally less than the **theoretical yield.** It means that not all the reactants are converted to products. In grade 10, learners will determine the theoretical yield of a product when if the reaction is started with a known mass of reactant.

PRE-KNOWLEDGE
A basic understanding of the following:

- Balancing of equations
- Stoichiometric ratios
- The molar concept

BASELINE ASSESSMENT[5 min]

- Educator asks a few general questions determine learner's level of understanding of the molar concept and balancing of equations and stoichiometric ratios.

2.2. Main Body (Lesson presentation) [15 min]

- Educator can use an example to explain to learners how to calculate the theoretical yield of products in a chemical reaction.

➢ In an investigation to determine the amount of iron that can be recovered from iron ore, you start the reaction with 150 g of Fe_2O_3. Assume that all the Fe_2O_3 will react during the process (Fe_2O_3 is the limiting reactant) Determine the theoretical yield of Fe.

➢ The unbalance chemical equation for the reaction, is:

$Fe_2O_3(s) + CO(g) \longrightarrow Fe(s) + CO_2(g)$

➢ Allow learners to balance the equation:

$Fe_2O_3(s) + 3CO(g) \longrightarrow 2Fe(s) + 3CO_2(g)$

- Convert 150 g Fe_2O_3 to mole: $n = \frac{m}{M} = \frac{150}{160}$ = 0,94 mole Fe_2O_3 formula units.
- Determine the stoichiometric ratio, by using the coefficients in the balanced equation.

Fe_2O_3	O_2
1 mole	2 mole
0,94 mole	x mole

x = (2)(0,94) = 1,88 mole

1,88 mole Fe atoms is obtained from 0,94 mole Fe_2O_3

- Convert 1,88 mole Fe atoms to mass in gram.

$n = \frac{m}{M}$

$m = n \cdot M$ = (1,88)(56) = 105,25 g Fe atoms

LEARNER ACTIVITY **[20 min]**
CLASS WORK (Peer assessment)

- Learners do a class work assignment to practice the concept of theoretical yield.

1. Methanol ($CH_3OH(\ell)$) can be decomposed to form hydrogen gas and carbon(II)oxide. During a decomposition reaction, 125 g of methanol is decomposed.
   (a) Write the formula for carbon(II)oxide and give the general name of the compound.
   (b) Write a balanced chemical reaction for the above mentioned decomposition reaction.
   (c) Determine the theoretical yield of $H_2(g)$
2. When calcium carbonate is heated, it decomposes into calcium oxide and carbon(IV)oxide gas. During such a reaction Megan heated 50 g of calcium carbonate and captures the gas in a syringe.
   (a) Write the formula for carbon(IV)oxide and give the household name of the compound.
   (b) Write a balanced chemical equation for the reaction described above.
   (c) Determine the volume of carbon(IV)oxide produced during the reaction at STP..
   (d) Determine the theoretical yield of carbon(IV)oxide.

ANSWERS TO CLASSWORK ACTIVITY

1.

(a) CO(g) – Carbon monoxide

(b) $CH_3OH(\ell) \longrightarrow 2H_2(g) + CO(g)$

(c) $M(CH_3OH) = 12 + 3(1) + 16 + 1 = 32\ g\cdot mol^{-1}$

$n = \frac{m}{M} = \frac{125}{32}$ = 3,91 mole CH_3OH-molecules

CH_3OH	$H_2(g)$
1 mole	2 mole
3,91 mole	x mole

x = 7,82 mole H_2

$n = \frac{m}{M}$

$m = n \cdot M$ = (7,82)(2) = 15,64 g H_2 molecules.

2.

(a) $CO_2(g)$ carbon dioxide

(b) $CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$

(c) $n = \frac{m}{M} = \frac{50}{100}$ = 0,5 mole $CaCO_3$ formula units

(d) $n = \frac{V}{V_0}$

(e) $V = n \cdot V_0$ =(0,5)(22,4) = 11,2 dm^3 $CO_2(g)$ molecules

(f) $n = \frac{m}{M}$

$m = n \cdot M$ = (0,5)(44) = 22 g $CO_2(g)$ molecules.

3. Conclusion [15 min]

- Learners mark the class work activity.
- Educator summarises important aspects of the lesson, reinforcing what needs to be remembered and recalled

HOMEWORK QUESTIONS/ ACTIVITY Use Physical Science written by Volunteers – Siyavula, End of the chapter exercise p 355 16,17 [20 min]
Resources: Worksheets, power point presentation (if available) chalk- or white board, prescribed text books; CAPS-document (page 52).

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	27	TOPIC	Quantitative aspects of chemical change: Basic stoichiometric calculations – Time: 60 min	Lesson	3

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	**At the end of the lesson learners should be able to:** • Calculations based on concentration, mass, moles, molar mass and volume		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Question and answer, explanation.

Classwork activity to practice different applications of stoichiometric calculations.

2. LESSON DEVELOPMENT

2.1 Introduction [5 min]

- Educator explains that the number of moles of a certain compound per unit volume is considered as the concentration.

PRE-KNOWLEDGE

A basic understanding of the following:

- Stoichiometric principles
- The molar concept.

BASELINE ASSESSMENT[5 min]

- Educator Mark homework activity and discuss difficulties that learners have encountered

2.2. Main Body (Lesson presentation) [40 min]

Lesson 14 and 15 both covers stoichiometric calculations. In lesson 15 more advanced examples will be discussed.

- Educator explains the fact that there are limiting reactants in most chemical reactions. It implies that one of the reactants is in excess and that a certain amount of this substance will not be used up.
- Leaners have to understand that all the given quantities have to be converted to mole before the limiting reactant can be determined.

Example 1: Hydrogen reacts with nitrogen to form ammonia gas. 100 cm^3 of hydrogen gas is mixed with 100 cm^3 of nitrogen gas

(a) Write a balanced chemical equation for the reaction

(b) Determine which of the gases is in excess.

(c) Calculate the total volume of all the gases in the container after the reaction has reached completion.

(d) Calculate the mass of ammonia that can be produced during the reaction.

Answers

(a) $1N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

(b) Convert the given volumes to mole.

$n = \frac{V}{V_0} = \frac{100}{22,4}$ = 4,46 mole

The reaction is started with 4,46 mole of N_2(g) and 4,46 mole H_2(g)

Consider the stoichiometric ratios to find the limiting reactant.

Table 1

N_2	H_2
1	3
4,46	x

OR

Table 2

N_2	H_2
1	3
x	4,46

- The answer for x, in the first table is (3)(4,46) = 13,38 mole H_2(g). Only 4,46 mole H_2(g) is available. This indicates that H_2(g) is the limiting reactant and that N_2(g) is in excess.
- In table 2: 3x = 4,46
  x = 1,49 mole N_2(g) reacts.

N_2(g) is in excess

(c)

N_2	H_2	NH_3
1	3	2
1,49	4,46	2,97

Mole N_2(g) that does not react = 4,46 – 1,49 = 2,97 mole N_2(g) in excess

Mole NH_3(g) formed = 2,97

There is (2,97 + 2,97) = 5,94 mole of N_2(g) and NH_3(g) in the container when all the H_2(g) has been used up.

Convert to volume: $n = \frac{V}{V_0}$

$V = nV_0$ = (5,94)(22,4) = 133,06 cm^3

(d) From (c) 2,97 mole of NH_3(g) is formed.

Convert mole to gram: M(NH_3) = 17 $g \cdot mol^{-1}$

$n = \frac{m}{M}$

m = nM

m = (2,97)(17)

m = 50,49 g NH_3(g) is formed

Example 2

Aluminium and oxygen reacts according to the following equation: $2Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$. There is 3 mole aluminium and 2 mole oxygen on a container and it is allowed to react.

(a) Determine the number of moles of aluminium that is in excess.
(b) Calculate the mass of aluminium oxide formed during the reaction.

Answers

(a) Table 1

Al	O_2
2	3
3	x

Table 2

Al	O_2
2	3
x	2

- Table 1: 2x = 9
  x = 4,5 mole O_2(g) is needed to react with 3 mole Al(s) Only 2 mole is available.
- Table 1: 3x = 4

  x = 1,33 mole Al(s) is needed to react with 2 mole of O_2(g).
- Both these calculations prove that Al(s) is in excess.

3mole – 1,33 mole = 1,67 mole of aluminium is in excess.

(b)

Al	O_2	Al_2O_3
2	3	2
1,33	2	1,33

Convert 1,33 mole Al_2O_3(s) to mass: $M(Al_2O_3) = 2(27) + 3(16) = 102\ g\cdot mol^{-1}$

$$n = \frac{m}{M}$$

$$m = nM$$

m = (1,33)(102)

m = 135,66 g Al_2O_3(s) is formed during the reaction.

3. Conclusion [10 min]

- Educator summarises important aspects of the lesson, reinforcing what needs to be remembered and recalled

HOMEWORK QUESTIONS/ ACTIVITY Use Physical Science written by Volunteers – Siyavula, End of chapter exercise (choose from question 1 -14 [30 min]
Resources: Worksheets, power point presentation (if available) chalk- or white board, prescribed text book; CAPS-document (page 52).

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	28	TOPIC	Vectors and Scalars Physical quantities	Lesson	1

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	At the end of the lesson learners should be able to: • List the physical quantities • Define a scalar and a vector quantity		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:
Demonstration ; Question and answer

2. LESSON DEVELOPMENT
2.1 Introduction

a) PRE-KNOWLEDGE learners need understanding of the following:
i) Fundamental quantities
ii) Magnitude or size

b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]

QUESTIONS for the **BASELINE ASSESSMENT**

i) Give three examples of fundamental quantities

ii) In which unit is distance measured? Also provide symbol for this unit.

iii) Name two types of physical quantities

c) Do corrections

i) Mass, time, distance, temperature etc

ii) Metres (m)

iii) Fundamental/basic and derived quantity

2.2 Main Body (Lesson presentation) [30 min]

- Physical quantity is a property of a phenomenon, body or substance that can be quantified by measurement.
- Physical quantities include amongst others : time, distance, temperature, mass, amount of a substance, area, density, power, momentum, speed, weight, force and a volume.
- These quantities have units of measurement. Both quantity and unit of measurement have specific symbols.
- A physical quantity could either be a fundamental quantity (quantities that are basis for the system of measurement) or a derived Quantity (set of quantities generated from fundamental quantities)

Quantity	Symbol	SI unit (name)	Symbol for SI unit
Time	t	second	s
mass	m	kilogram	kg
distance	x,y,r,d,l	metres	m
temperature	T	Kelvin	K
Area	A	Square metre	m^2
speed	v	metre per second	$m \bullet s^{-1}$
Force	F	Newton	N
Volume	V	Cubic metre	m^3

Scalar is a physical quantity with magnitude (size and unit) only. e.g. mass of 30 kg, current of 3 A, time of 3 s etc
Vector is a physical quantity with magnitude and a direction. e.g. Weight of 720 N downwards, displacement of 20 m to the North, Velocity of 2 $m \bullet s^{-1}$ west etc.

Learners activities 10 min

2.2.1 What is the difference between fundamental units and derived units?

2.2.2 List two fundamental units and two derived units

2.2.3 Define a scalar quantity and give two examples in both names, and quantities

2.2.4 Why is distance a scalar quantity whereas displacement is a vector quantity?

2.2.5 Explain why it is scientifically wrong to say a weight of 50 kg

Corrections [7 min]

3. Conclusion

Activity to Re-enforce lesson(Educator may summarise the main aspects of the lesson).[**5 min**.]

HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

RESOURCES USED: chalkboard, worksheets, mass pieces, measuring tape

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

Possible Answers

2.2.1 Fundamental units are those units that are basis for the system of measurement, and derived units are units generated from fundamental units

2.2.2 Fundamental units are : s, m and kg

Derived units are $m \cdot s^{-1}$, m^3 and N

2.2.3 a scalar quantity is a physical quantity with magnitude only (no direction)
time (13 s), mass (5 kg) and temperature of 278 K

2.2.4 Distance is the magnitude of the path length followed by an object and displacement is the shortest distance along a straight line between beginning of the motion and the end of the motion.(How far is the object relative to the start point ?)

2.2.5 Weight is a force experienced by an object due to gravitational acceleration downwards. Scientifically weight must be measured in N and not in kg.

GRADE	10	SUBJECT	Physical Sciences	WEEK	28	TOPIC	Differentiate between vector and scalar	Lesson	2

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Represent the force factor and the magnitude of the force • Differentiate between vector and scalar		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:
Demonstration ; observation

2. LESSON DEVELOPMENT
2.1 Introduction

a) PRE-KNOWLEDGE learners need understanding of the following:
(i) Definitions of a vector and a scalar
ii) Examples of vectors and scalar

b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]

QUESTIONS for the **BASELINE ASSESSMENT**

i) Define a vector quantity

ii) Give two examples of a vector quantity and two examples of a scalar quantity

iii) Write the symbolic representation of a speed and velocity

c) Do corrections

i) A vector is a physical quantity with magnitude and direction

ii) Vectors: Force and acceleration , Scalar : time and distance

iii) Speed (v) and velocity ($\vec{v}$)

2.2 Main Body (Lesson presentation) [30 min]

A vector is a physical quantity with magnitude and direction. Symbols for vectors are typed on bold letters or with an arrowhead above the symbol. e.g. $\vec{v}$, $\vec{F}$ and $\vec{a}$.

These examples are velocity, Force factor and an acceleration. The difference between a force(F) and a force factor ($\vec{F}$) is that F denotes a magnitude of the force and $\vec{F}$ denotes magnitude and a direction of that force .

Example :

F = 45 N and $\vec{F}$ = 45 N west

A force can be in the direction of motion or in a direction against the motion. If a direction of the force is not given in the question, it is advisable not to include it in the answer. The safer way would be to write forward or backwards, in the direction of motion, in the direction opposite the direction of motion etc. A question that asks for the magnitude of a vector, e.g. calculate the magnitude of velocity, requires the answer to be a magnitude, without a direction.

Examples of contact and action-at-distance(non-contact) forces are listed in the table below.

Contact Forces	Action-at-a-Distance Forces
Frictional Force	Gravitational Force
Tension Force	Electrical Force
Normal Force	Magnetic Force
Air Resistance Force	
Applied Force	
Spring Force	

A scalar is a physical quantity with magnitude only. e.g. t, m and v . These symbols are for time, mass and speed respectively.
m = 3 kg , t = 32 s and D = 33 m. If a question asks for a scalar, don't attach a direction to the answer.

Learners activities 10 min

2.2.1 What is the difference between F and $\vec{F}$?

2.2.2 On two different occasions during a high school soccer game, the ball was kicked simultaneously by players on opposing teams. In which case (Case 1 or Case 2) does the ball undergo the greatest acceleration? Explain your answer.

2.2.3 What is meant by the contact forces? Give three examples

2.2.4 What is the sum of all forces acting on an object called?

A: gravity
B: reaction force
C: acceleration
D: net force

2.2.5 In a tug of war, when one team is pulling with a force of 100 N and the other 80 N, what is the net force?

A: 20 N
B: 80 N
C: 100 N
D: 180 N
Corrections [7 min]

3. Conclusion
Activity to Re-enforce lesson(Educator may summarise the main aspects of the lesson).[**5 min**.]

HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

RESOURCES USED:

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

Possible Answers

2.2.1 The difference between a force(F) and a force factor ($\vec{F}$) is that F denotes a magnitude of the force and $\vec{F}$ denotes magnitude and a direction of that force .

2.2.2 **Case 2** results in the greatest acceleration. Even though the individual forces are greater in Case 1, the net force is greatest in Case 2. Acceleration depends on the net force; it is not dependent on the size of the individual forces.

2.2.3 These are the forces that are in touch with the object

2.2.4 D (Net force)

2.2.5 A ($\vec{F}$ = 20 N)

GRADE	10	SUBJECT	Physical Sciences	WEEK	28	TOPIC	Properties of vectors - Time: 60 min	Lesson	3

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Represent the properties of vectors(equality, negative vector, addition and subtraction of vectors) schematically		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:
Demonstration ; Question and answer method

2. LESSON DEVELOPMENT
2.1 Introduction
a) PRE-KNOWLEDGE learners need understanding of the following:
(i) Physical quantities
(ii) Definitions of vector and scalar quantities

b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]

QUESTIONS for the BASELINE ASSESSMENT

i) Define a vector quantity and give three examples

ii) What is meant by a fundamental quantity ?

iii) Give two examples of derived quantities

c) Do corrections

i) A vector is a physical quantity with both magnitude and direction. e.g. displacement of 20 m North, Velocity of 2 $m \cdot s^{-1}$ west and Weight of 500 N downwards.

ii) physical quantities that are basis for the system of measurement.

iii) speed, force, area etc

2.2 <u>Main Body (Lesson presentation) [30 min]</u>

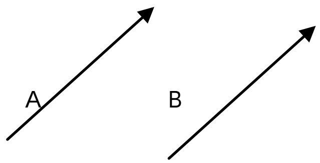
A scalar is a physical quantity with magnitude only. e.g. distance of 20 m, mass of 50 kg etc as compared to the vector on (i) in the baseline assessment above. A vector force will therefore have the symbolic representation $\vec{F}$.

- The sum of two scalars A and B is equal to A+B
- The sum of two vectors A and B is not equal to A + B, except when A and B are in the same direction.
- A scalar quantity divided by a scalar quantity is a scalar , but a vector quantity divided by a vector quantity is not equal to a vector (quotient)

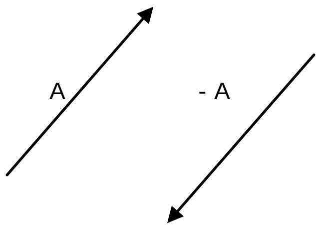
Directions an be given using one of the methods below

The reference points above can be used to describe a vector. To represent a vector graphically, a tail- head method is used, wherein the size of the line represents a magnitude and the arrow head represents a direction.
A scale must be used. Example : 1 cm = 10 km.

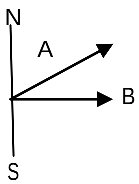
- Two vectors are equal if they have the same magnitude and same direction regardless of whether they have the same initial point.

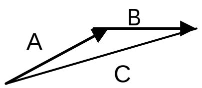


- A vector having the same magnitude as A but in opposite direction to A is denoted by – A.



- The sum of two vectors A and B is a vector C, which is obtained by placing the initial point of B on the final point of A and then drawing a line from the initial point of A to the final point of B.





- Vector subtraction is the difference of two vectors A and B, which is equal to C.

A - B = C or C = A - B

Learners activities 10 min

2.2.1 A man walks 10 km east , rests for a while and walks another 3 km due east. Graphically represent the vector sum of the two vectors

2.2.2 In a Tug of War, two strong men are pulling, each to the direction opposite of the other man. If they each pull with the force of magnitude F, find the magnitude and the direction of the resultant vector $\vec{F}$.

2.2.3 What is the difference of the two forces 3 N at 45^0 and 4 N at 315^0 ?

2.2.4 Represent the following graphically:

2.2.4.1 25 N in the direction 225^0

2.2.4.2 30 N in the direction 270^0

2.2.4.3 60 N at 100^0

Corrections [7 min]

3. Conclusion

Activity to Re-enforce lesson(Educator may summarise the main aspects of the lesson).[5 min.]

HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

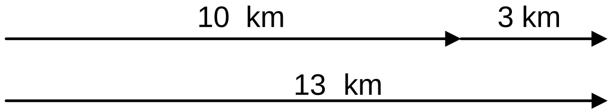
RESOURCES USED: Worksheets, protractor, ruler, calculator

Reflection/Notes:

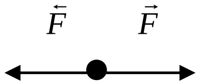
Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

Possible Answers

2.2.1



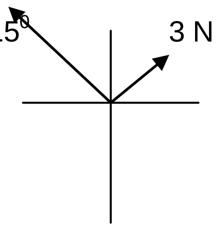
2.2.2



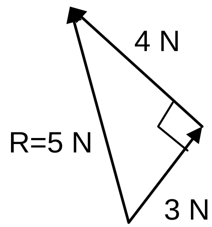
the resultant vector $\vec{F} = \vec{F} - \vec{F}$ (Since $\vec{F} = -\vec{F}$)
= 0 N

2.2.3 The magnitude of each force and the angle at which the force is applied or acting.

4 N at 315^0



3 N at 45^0 (not drawn to scale)

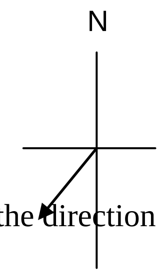


$R^2 = 4^2 + 3^2$
R = 5N

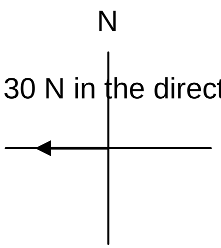
tan ɵ =

NB- Draw these diagrams to scale

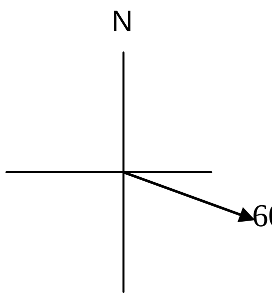
2.2.4



25 N in the direction 225^0



30 N in the direction 270^0



60 N at 100^0

GRADE	10	SUBJECT	Physical Sciences	WEEK	28	TOPIC	Resultant vector - Time: 60 min.	Lesson	4

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Define resultant vector • Determine the resultant vector graphically using head to tail method and using calculation		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:
Demonstration ; observation, question and answer

2. LESSON DEVELOPMENT
2.1 Introduction

a) PRE-KNOWLEDGE learners need understanding of the following:
(i) Scalar and vector quantities
(ii) Examples of scalar and vector quantities

b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]

QUESTIONS for the **BASELINE ASSESSMENT**

i) Define a scalar and give two examples

ii) Apart from the magnitude, what other information is provided on a vector?

iii) How can a vector of magnitude **Q**, but in opposite direction to that of **Q** be represented?

c) Do corrections

i) A scalar is a physical quantity with magnitude only. e.g. mass, time, distance

ii) The direction of the displacement

iii) It is denoted by **-Q**

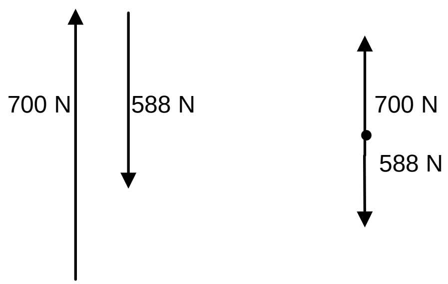
2.2 Main Body (Lesson presentation) [30 min]

A Resultant Vector is one vector which can represent the combined effect of all the other vectors together. Vectors can be in the same direction, opposite directions or at an angle.

Vectors in opposite direction

If two forces are acting on an object but in opposite directions, the vector sum is equal to the difference in magnitude of the two forces, but to the direction of the greater force.

Example 1: A man applies a force of 700 N to **lift up** the bucket of mass 60 kg from the well. Find the resultant vector.
Hint. The bucket has a mass and therefore experiences gravitational force **downwards.** The weight of the mass is calculated from W = mg
, W = 60 x9,8, W = 588 N downwards. The two forces acting on the bucket can be represented :



Resultant Force on the bucket will be calculated : consider up as positive

$\vec{F}$ = 700 N+ (-588N)

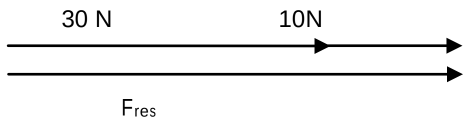
= + 112 N

= 112 N upwards, because the answer is positive and upward is chosen as positive

Vectors in the same direction

Example 2
A donkey is stuck in the mud. The owner applies a force of 30 N to the direction west in an attempt to get it out with a rope. His son realizes that the father is struggling, came to rescue the father and they both pulled the rope westwards. The magnitude of the son's force was found to be only 10 N. Find the resultant force on the donkey.

Solution (Consider west to be positive)

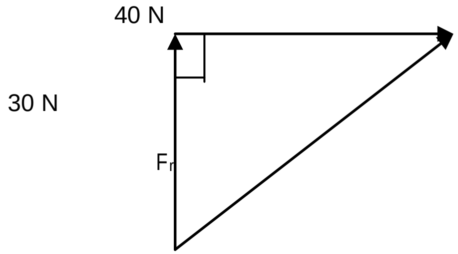


Resultant $\vec{F}$ = 30 N + 10N
= 40 N west

Vectors at an angle

Example 3

A tourist pushes his car with a force of 30 N north. And then 40 N west to locate a petrol pump at the filling station. Find his resultant force.



calculation

$F_r^2 = 40^2 + 30^3$
$= 1600 + 900$
$= 2500$
$F_r = 50$ N
tan ϴ = 4/3
ϴ = $\tan^{-1}$(1.3333333333)
= 53.13 ^{0}

Graphical method

Scale : 1 cm : 10 N. Draw the vectors according to the scale. The 30 N force will be 3 cm on the page and the 40 N force will be 4 cm. And then measure the length of the resultant force

Using a **protractor,** with 0^0 above the 30 N vector, measure the angle at which the resultant force is.

Learners activities 10 min

2.2.1 A car travels 20 km , south, and then 12 km at 270^0. Determine the resultant displacement using a scale drawing

2.2.2 A ship steams at a distance 100 km in a direction of 30^0 E of N while the ocean current displaces it 50 km to the east. Determine the resultant displacement graphically.

2.2.3 An aircraft undergoes a displacement of 50 km at 30^0 due to the crosswinds while actually wanting to fly in an easterly direction. Determine the easterly and northerly displacement components which could have caused the resultant displacement.

2.2.4 Define a resultant vector

2.2.5 In a scale of 1cm : 20 N, Explain the meaning of this ratio. What will be the length of line representing a force of 130 N?

Corrections [7 min]

3. Conclusion

Activity to Re-enforce lesson(Educator may summarise the main aspects of the lesson).[**5 min**.]

HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

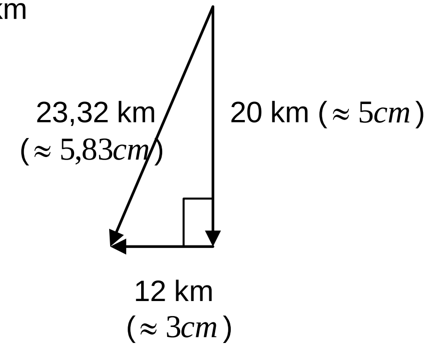
RESOURCES USED: Protractor, rule, calculator, whiteboard or chalkboard

Reflection/Notes:

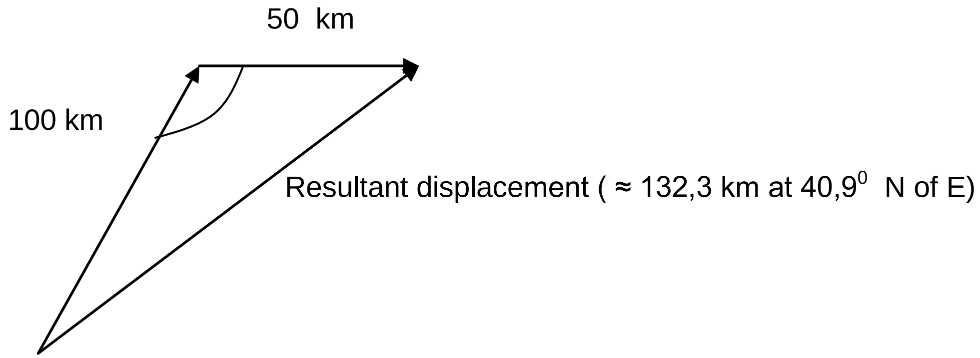
Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

Possible Answers

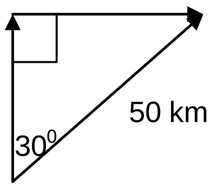
2.2.1 scale 1 cm : 4 km



2.2.2



2.2.3



Horizontal component :

$$\sin 30^0 = \frac{x}{50}$$

X = 25 km to the east

Vertical components :

$$\cos 30^0 = \frac{y}{50}$$

y = 43,3 km to the north

2.2.4 Resultant vector is that single vector with the same effect as all other vectors together.

2.2.5 1 cm on the sketch represents 20 N of the real force. Length of line representing 130 n will be equal to 6,5 cm.

GRADE	10	SUBJECT	Physical Sciences	WEEK	29	TOPIC	Frame of reference	Lesson	1

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Describe the concept of frame of reference. • Explain what the frame of reference is consisted of. • Define one dimensional motion.		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Demonstration ; observation , question and answers

2. LESSON DEVELOPMENT

2.1 Introduction

a) PRE-KNOWLEDGE learners need understanding of the following:

(i) vectors and scalars

(ii) directions

b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]

QUESTIONS for the **BASELINE ASSESSMENT**

i) What is the difference between a vector and a scalar quantity?

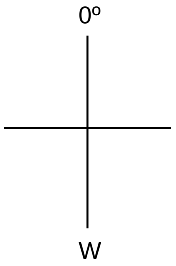
Ii) Draw two diagrams to show directions in terms of angles and in terms of the geographical direction.

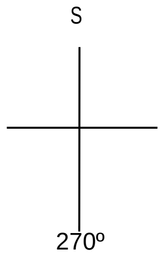
Iii) Define a frame of reference in Physics.

c) Do corrections

i) A scalar has magnitude and a vector has both magnitude and a direction

ii)





iii) **A frame of referenc**e is the coordinate system or set of axes within which to measure the position, orientation , motion and other properties of object in it

2.2 Main Body (Lesson presentation) [30 min]

A frame of reference is the coordinate system or set of axes within which to measure the position, orientation , motion and other properties of object in it. A frame of reference has an origin and a set of direction , up and down, east and West. There are two types of frame of reference: **Inertial frame of reference and non inertial frame of reference**

Inertial frame of reference
- Remains at rest or moves at constant velocity with reference to the other.
- Newton's laws of motion are valid

Non-inertial frame of reference

- A body not acted upon by external force is accelerating
- Newton's laws of motion are not valid

Examples of frame of reference will include amongst others:-

A person standing on the ground. A passenger seated in the train and Free falling object.

One dimensional motion is a motion along a straight line with constant or changing speed

Learners activities 10 min

2.2.1 Define an inertial frame of reference

A train truck moves at 30 km•h^{-1} in northerly direction. James walks forward the train truck at 3 km•h^{-1}. Zola is standing on the platform and watching James walk.

2.2.2. At what velocity does Zola see the train moving?

2.2.3 At what velocity does James see the train moving ?

2.2.4 From which frame of reference will the velocity be 33 $km \bullet h^{-1}$ north

If Zola starts moving southwards at 2 $km \bullet h^{-1}$:

2.2.5 What is the velocity of Zola relative to the train?

2.2.6 What is the velocity of Zola relative to James ?

Corrections [7 min]

3. Conclusion

Activity to Re-enforce lesson(Educator may summarise the main aspects of the lesson).[**5 min**.]

HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

RESOURCES USED: calculators, boards

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

Possible Answers

2.2.1 **Inertial frame of reference** is the frame of reference that remains at rest or moves at constant velocity with reference to the other and it obeys Newton's laws of motion

2.2.2 V_{ZG} = 30 km•h^{-1} Northwards

2.2.3 V_{TJ} = 30 + (-3)

= 27 km•h^{-1} Northwards

2.2.4 From the stationary position outside the train (ground) observing both James and train moving at their current velocities but James moving Southerly

2.2.5 V_{ZT} = 30 + 2

= 32 km•h^{-1} southwards

GRADE	10	SUBJECT	Physical Sciences	WEEK	29	TOPIC	Position, distance and displacement - Time: 60 min.	Lesson	2

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	

LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Define a position relative to a reference point • Define distance and indicate what makes distance a scalar quantity • Define displacement as a change in position

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:
Demonstration ; observation

2. LESSON DEVELOPMENT
2.1 Introduction

a) PRE-KNOWLEDGE learners need understanding of the following:
(i) Frame of reference
(ii) Definitions of distance and displacement
(iii) Graphical representation of distance and displacement

b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]

QUESTIONS for the **BASELINE ASSESSMENT**

i) Define distance and displacement. In which unit are they measured?

ii) Koos cycled from home to school, but passed through a shop which is not on the way to school. Consider his home to be **A, shop B** and school to be **C.** Draw a rough sketch to represent distance Koos travelled as well as the displacement

c) Do corrections

2.2 Main Body (Lesson presentation) [30 min]

Practical demonstration

Aim : To investigate the difference between displacement and the distance

State the investigative question : What is the difference between distance and displacement of a moving object?

Hypothesis : distance is always greater than displacement

Variables : Dependent variable - distance and displacement
Independent variable - time
Constant variable - length of the track / force pushing the toy car

Apparatus : adjustable track, toy car, metre rule, measuring tape, rubber bands, cardboard, prestik and scissors

Precaution : Always stretch the rubber-band to the same length to provide equal force
.
Method A : Use the track provided from the toy set and build a long straight track. Attach the rubber band at the end of ruler and the other end to the toy-car. Stretch the rubber band to a specific length and record it. Release the toy-car and record the distance covered by this toy-car. What will the displacement be? (remember displacement is a vector quantity.(Magnitude and direction). Compare distance and displacement.
$\Delta x = D$

Method B : With the same materials, build a curved track of equal magnitude as the straight track, but bending such that it ends half way towards the start point .Cut card boxes and draw arrows showing the direction of the motion at four different points. Stretch the rubber band as above release the car and measure the distance covered. Measure the displacement of the car and compare.
$\Delta x < D$
Analysis of results and conclusion: Generally $\Delta x < D$, except when the motion is along the same straight line where $\Delta x = D$.

Position is the place where the object is relative to the reference point. A reference point is therefore a point from which the position of an object is measured. e.g. a student who leaves home to school, on his arrival to school 5 km away from home: Home is the reference point and the school becomes the position where the student is.

The path length followed by a moving object is **Distanc**e. Distance is a scalar quantity since it has magnitude only, and no direction. **Displacement** is the change in position of an object relative to its starting point (the shortest distance along the straight line between the start of the motion and the end of the motion. Displacement is a vector quantity since it has magnitude and direction.

If an object moves around a circular path (or any path) and ends at the beginning of the motion, the displacement will be zero and the distance will be magnitude x (certain value) or the circumference of the circle for this example.

Learners activities 10 min
2.2.1 Define displacement and categorise it as scalar or vector

2.2.2 What is meant by a position

2.2.3 List the differences between the distance and displacement. Indicate in what way are distance and displacement similar.

2.2.4 What is the ratio of distance and displacement covered by the particle in a semicircle of radius r?

2.2.5 What is meant by reference point?

Corrections [7 min]

3. Conclusion

Activity to Re-enforce lesson(Educator may summarise the main aspects of the lesson).[**5 min**.]

HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

RESOURCES USED: adjustable track, toy car, metre ruler, measuring tape, rubber bands, cardboard, prestik and scissors

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

Possible Answers

2.2.1 Displacement is the shortest distance along the straight line between two points. It is a vector quantity since it has direction.

2.2.2 Position is the place where the object is relative to the reference point

2.2.3 The path length followed by a moving object is **Distanc**e. Distance is a scalar quantity since it has magnitude only, and no direction.

Displacement is the change in position of an object relative to its starting point (the shortest distance along the straight line between the start of the motion and the end of the motion. Displacement is a vector quantity since it has magnitude and direction.

Displacement and distance are the same if the object is moving along a straight line.

2.2.4 Distance : displacement

½ π x diameter : diameter

½ π : 1

π : 2 or

3,14 : 2

2.2. 5 A reference point in physics is a point in space, regardless of the type of geometry that you are using that stays still and does not move. From this point the behavior of an object moving through that space can be determined.

GRADE	10	SUBJECT	Physical Sciences	WEEK	29	TOPIC	Distance, displacement and calculations	Lesson	3

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Define displacement and distance, and give the differences between distance and displacement • Calculate distance and displacement for one dimensional motion		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Demonstration ; observation

2. LESSON DEVELOPMENT

2.1 Introduction

a) PRE-KNOWLEDGE learners need understanding of the following:

(i) definitions of distance and displacement

(ii) symbolic representation of the distance and displacement

b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]

QUESTIONS for the **BASELINE ASSESSMENT**

i) define displacement and give symbolic representation of displacement

ii) what are the differences between displacement and distance ?

c) Do corrections

i) displacement is the change in position with reference to the starting point

Differences between displacement and distance

	Displacement	Distance
Symbol	Δx , Δy	D
definition	Displacement is that single vector with the same effect as other vectors together	Distance is the length of the path followed by a moving object
	Magnitude and direction (vector quantity)	Magnitude only (scalar)
	Can be positive or negative	Positive only

2.2 Main Body (Lesson presentation) [30 min]

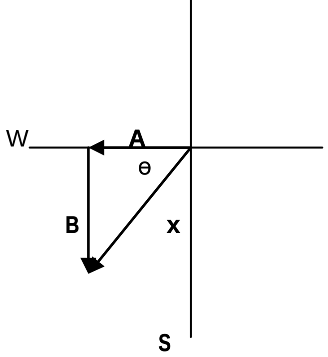
Distance is the length of the path followed by a moving object. Distance is a scalar quantity and can therefore be represented by magnitude only, no direction. Displacement is that single vector with the same effect as other vectors together. It is a vector quantity with magnitude and direction. Displacement starts at the beginning of the motion and ends at the end of the motion. It must be represented by the line with an arrowhead. Wherein the line indicates the magnitude and the arrowhead indicates the direction. An object ending at its start point has a displacement of zero (0 m)

Differences between displacement and distance

	Displacement	Distance
Symbol	Δx , Δy	D
definition	Displacement is that single vector with the same effect as other vectors together	Distance is the length of the path followed by a moving object
	Magnitude and direction (vector quantity)	Magnitude only (scalar)
	Can be positive or negative	Positive only

Example

A car travels 3 km due west and then 4 km due south as shown in the sketch below:



a) What is the car's distance ?

b) Find the displacement of the car

Solution : D = A + B

= 3 + 4

= 7 km

(b) $\Delta x^2 = A^2 + B^2$

$\mathbf{\Delta x^2 = 3^2 + 4^2}$

$\Delta x = 5$ km

$\mathbf{\theta = \tan^{-1}(4/3)}$

$\mathbf{= 53.1^0}$ **South of west**

Learners activities 10 min

2.2.1 Old American cowboys went horse riding. They went 5 km west and the sun intensity caused them to change the direction. They headed North for 12 km and then camped.

a) Illustrate the motion graphically.

b) Calculate the distance covered

c) Find the resulting displacement of the cowboys

2.2.2 A 500 m tall building casts a shadow 800 m long over level ground. What is the sun's elevation angle above the horizon ?

2.2.3 A bridge 50 m long crosses a chasm. If the bridge is inclined at an angle 20^0 to the horizontal, what is the difference in height between the ends?

2.2.4 While a boat is being rowed across a river 800 m wide the boat is swept 200m downstream by the time it reaches the opposite bank. Determine the displacement of the boat by means of an accurate scale drawing

Corrections [7 min]

3. Conclusion

Activity to Re-enforce lesson(Educator may summarise the main aspects of the lesson).[**5 min**.]

HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

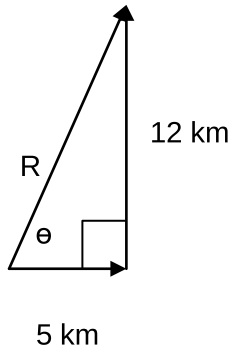
RESOURCES USED: straight toy track, toy cars, circular toy track

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

Possible Answers

2.2.1 a)



c) $R^2 = 5^2 + 12^2$ $\tan \theta = 12/5$

$R^2 = 169$ $= 2,4$

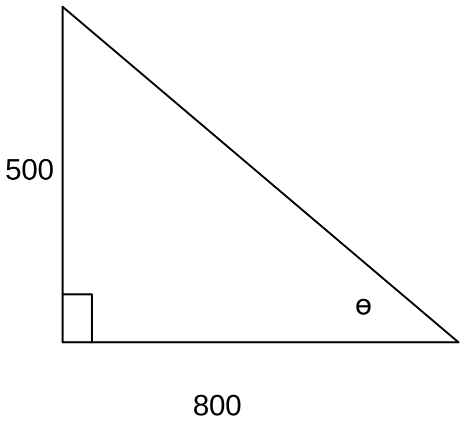
$R = 13$ km $\theta = \tan^{-1}(2,4)$

$R = 13$ km at $67,38^0$

b) Total distance covered (D) = 5 + 12

= 17 km

2.2.2

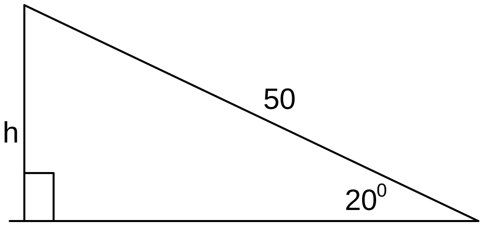


$\tan \theta = 500/800$

$\theta = \tan^{-1} 0,625$

$= 32,01^0$

2.2.3

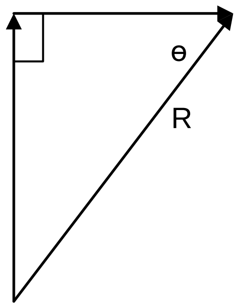


$\text{Sin } 20^0 = h/50$

$h = 50 \sin 20^0$
$h = 17{,}10 \text{ m}$

The difference in height between the two ends is 17,10 m

2.2.4



Not drawn to scale
Hint. 1 cm : 100 m
Length of resultant R = 8,25 cm

$\tan \theta = 800/200$
$\theta = \tan^{-1} 4$
$= 75{,}96^0$

GRADE	10	SUBJECT	Physical Sciences	WEEK	29	TOPIC	Average speed and average velocity – Time: 60 min	Lesson	4

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Define an average speed and illustrate that it is a scalar quantity • Define an average velocity and illustrate It is a vector quantity		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Demonstration ; observation , question and answer method

2. LESSON DEVELOPMENT

2.1 Introduction

a) PRE-KNOWLEDGE learners need understanding of the following:

(i) speed and velocity

ii) Vector and scalar quantities

b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]

QUESTIONS for the **BASELINE ASSESSMENT**

i) Classify speed and velocity as scalar or vector quantity

ii) Define speed and velocity

iii) Represent speed and velocity using symbol and signs

c) Do corrections

i) Speed is a scalar velocity is a vector quantity

ii) Speed is the rate at which an object covers a distance and velocity is the rate of change of object's displacement

iii) Speed v and velocity $\vec{v}$

2.2 **Main Body (Lesson presentation) [30 min]**

Speed is the rate at which an object covers the distance. Constant speed is an unchanging speed. An object moves at constant speed if it travels equal distances in equal time interval. e.g. 100 m every 5 s. **An average speed** is the rate at which the total distance was covered.
Speed and average speed are both the scalar quantities. They have magnitude without a direction.

$v_{av} = \frac{\text{distance covered}}{\text{time taken}}$ or $v = \frac{D}{\Delta t}$ where v is the speed in $m{\cdot}s^{-1}$
D is the distance covered
Δt is the total time

Velocity is the rate of change of position / displacement. **Average velocity** is the total displacement divided by the total time taken. Remember to start by choosing one direction as positive when resolving vectors. Convert quantities into standard units . converting km to m, multiply by 1000, converting hour to seconds, multiply by 3 600 and converting $km.h^{-1}$ to $m{\bullet}s^{-1}$, divide by 3,6

And average velocity = $\frac{\text{displacement}}{\text{time taken}}$ or $\overline{v} = \frac{\Delta x}{\Delta t}$

Learners activities 10 min

2.2.1 Calculate the speed of a dog running through a field if he is covering 23.7 meters in 54 seconds.

2.2.2 If a cross country runner covers a distance of 347 meters in 134 seconds, what is her speed?

2.2.3 Which object has a greater velocity, a ball rolling down a 3.4 meter hill in six seconds or a fish swimming upstream and covering 5.4 meters in 0.4 minutes?

2.2.4 .Calculate the velocity of a mountain climber if that climber is moving northeast at a pace of 1.6 km in 1.4 hours? Give your answer in the SI unit for velocity.

Corrections [7 min]

3. Conclusion
Activity to Re-enforce lesson(Educator may summarise the main aspects of the lesson).[**5 min**.]

HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

RESOURCES USED: chalkboard, worksheets , calculators

Reflection/Notes:

Name of Teacher		HOD:	
Sign:		Sign:	
Date:		Date:	

Possible Answers

2.2.1 $\bar{v} = \frac{\Delta x}{\Delta t}$

$= \frac{23,7}{54}$

$= 0,44\ m{\cdot}s^{-1}$

2.2.2 $\bar{v} = \frac{\Delta x}{\Delta t}$

$= \frac{347}{134}$

$= 2,59\ m{\cdot}s^{-1}$

2.2.3 $\bar{v} = \frac{\Delta x}{\Delta t}$

$= \frac{3, 4}{6}$

$= 0,57\ m{\cdot}s^{-1}$

$\bar{v} = \frac{\Delta x}{\Delta t}$

$= \frac{5,4}{0,4}$

$= 13,5\ m{\cdot}s^{-1}$

Therefore the fish swimming has a higher speed than the rolling ball

2.2.4 1,6 km = 1,6 x 1000 and 1,4 hrs = 1,4 x 3600

$\bar{v} = \frac{\Delta x}{\Delta t}$

$= \frac{1\ 600}{5040}$

$= 0,32\ m{\cdot}s^{-1}$ North east

GRADE	10	SUBJECT	Physical Sciences	WEEK	30	TOPIC	$\overline{v}$ and $\vec{v}$ calculations - Time: 60 min.	Lesson	1

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	

LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Calculate average speed of an object • Calculate average velocity of an object

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Demonstration ; observation , question and answer method

2. LESSON DEVELOPMENT

2.1 Introduction

a) PRE-KNOWLEDGE learners need understanding of the following:

(i) Average velocity and average speed

ii) Equations for calculating velocity, speed, average speed and average acceleration

b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]

QUESTIONS for the **BASELINE ASSESSMENT**

i) Define speed

ii) What is the difference between speed and velocity?

iii) What are the units in which speed and velocity are measured respectively?

c) Do corrections

i) Speed is the rate at which distance is traversed

ii) Speed is a scalar quantity with magnitude only whereas velocity is a vector quantity with magnitude and a direction. Speed is always positive and velocity could either be positive or negative

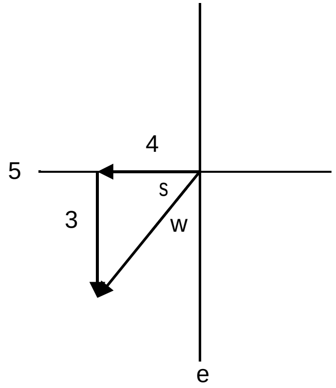
iii) Standard unit is $m.s^{-1}$ but $km.h^{-1}$ is also used

2.2 **Main Body (Lesson presentation) [30 min]**

Average speed is the rate at which total distance is covered and the **average velocity** is the total displacement divided by the total time.

$$V_{ave}\text{ (speed)} = \frac{\text{total distance}}{\text{time taken}} \quad \text{and} \quad V_{ave}\text{ (velocity)} = \frac{\text{displacement}}{\text{time taken}}$$

A car travels 3 km due west and then 4 km due south as shown in the sketch below:



I) Calculate the average speed if it takes 1minutes to reach end position
ii) Calculate the average velocity

s

Solutions
Distance and displacement were calculated previously :

D = A + B

= 3 + 4

= 7 km

(b) $\Delta x^2 = A^2 + B^2$

$\boldsymbol{\Delta x^2 = 3^2 + 4^2}$

$\Delta x = 5$ km

ɵ = $\tan^{-1}$ (4/3)

= 53.1^0 South of west

i) average speed ($\bar{v}$) = $\frac{D}{\Delta t}$

= 7/ (1x60)
= 0.16 $m.s^{-1}$

average velocity ($\vec{v}$) = $\frac{\Delta x}{\Delta t}$

= 5 / (1x60)
= 0,083 $m.s^{-1}$ **53.1^0 South of west**

Learners activities 10 min

2.2.1 Define velocity and provide the unit in which it is measured

2.2.2(a) A cyclist completes one circumference of a circular track with the radius 500 m at a constant speed of 10 $m \cdot s^{-1}$. How long does it take to complete the track ?

(b) What is the average velocity for the track?

2.2.3 A car drives for 100 km at an average speed of 80 $km \cdot h^{-1}$. How long will it take the car to cover the distance?

2.2.4 Bafana pushes a trolley full of tools 10 m to the right , then he pulls it 5 m to the left and then he pushes 7 m to the right as he checks maintenance of the building. It took Bafana only 2 minutes

2.2..4.1 what is the total distance covered by the trolley ?

2.2.4.2 Draw a vector diagram indicating all the displacements labelling them with their magnitudes

2.2.4.3 What will be the position of the trolley relative where it was first pushed?

2.2.4.4 Calculate the trolley's average velocity

Corrections [7 min]

3. Conclusion

Activity to Re-enforce lesson(Educator may summarise the main aspects of the lesson).[**5 min**.]

HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

RESOURCES USED: worksheets, chalkboard

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

Possible Answers

2.2.1 Velocity is the rate of change of displacement and it is measured in $m \cdot s^{-1}$

2.2.2 D (circumference) = $2\pi r$

$= 2(22/7)(500)$

$= 3142,86$ m

(a) Average speed (v) = $\frac{D}{\Delta t}$

$10 = \frac{3142,86}{\Delta t}$

$\Delta t = 314,29$ s

(b) Zero, the cyclist ended at the starting point. $\Delta x = 0$ m

2.2.3 100 km = 1×10^5 m and 80 $km \cdot h^{-1}$ = $80/3.6 \Rightarrow 22,22$ $m \cdot s^{-1}$

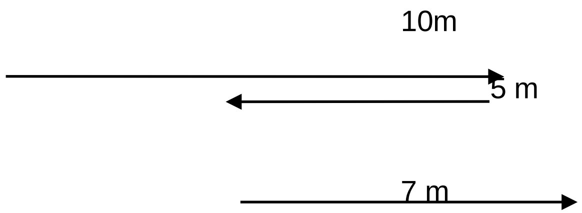
(v) = $\frac{D}{\Delta t}$

$22.22 = \frac{1 \times 10^5}{\Delta t}$

$\Delta t = 4500,45$ s

2.2.4.1 D = $10 + 5 + 7 \Rightarrow 22$ m

2.2.4.2 See on the right



2.2.4.3 $\Delta x = 10+(-5)+7 \Rightarrow 12$ m right

2.2.4.4 $\bar{v} = \frac{\Delta x}{\Delta t}$

$= \frac{12}{120}$

$= 0,1$ $m \cdot s^{-1}$ to the right

GRADE	10	SUBJECT	Physical Sciences	WEEK	30	TOPIC	Average acceleration - Time: 60 min.	Lesson	2

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Define average acceleration • Calculate average acceleration		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Demonstration ; observation , question and answer method

2. LESSON DEVELOPMENT

2.1 Introduction

a) PRE-KNOWLEDGE learners need understanding of the following:

(i) Velocity and average velocity

ii) Uniform increase in velocity and constant velocity

b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]

QUESTIONS for the **BASELINE ASSESSMENT**

i) Define a vector quantity

ii) Write the symbol for acceleration as a vector quantity

iii) Define acceleration

c) Do corrections

i) A vector is a physical quantity with both magnitude and direction

ii) $\vec{a}$

iii) Acceleration is the rate of change of velocity

2.2 Main Body (Lesson presentation) [30 min]

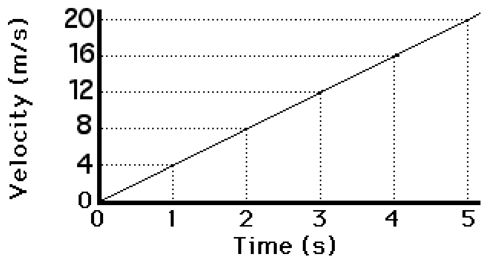
Acceleration ($\vec{a}$) is the rate of change of object's velocity. Average acceleration($\vec{a}$) = $\frac{\Delta v}{\Delta t}$ which can be written as $\vec{a} = \frac{v_f - v_i}{\Delta t}$

Acceleration is a vector quantity that has both magnitude and a direction. e.g. $\vec{a}$ = 2 ms^{-2} west. It is in a specific direction, unlike speed which is just a magnitude. Only constant (uniform) acceleration will be studied in this section. Constant acceleration occurs when there is a constant increase in velocity in every specific equal interval. The table below shows an accelerating object changing its velocity by a constant amount each second.

An object with a constant acceleration should not be confused with an object with a constant velocity. If an object is changing its velocity, whether by a constant amount or a varying amount - then it is an accelerating object. And an object with a constant velocity is not accelerating. Since accelerating objects are constantly changing their velocity, one can say that the distance traveled/time is not a constant value. A falling object for instance usually accelerates as it falls.

Time (s)	0	1	2	3	4
Velocity ($m \cdot s^{-1}$)	0	4	8	12	16

The graph can be plotted to represent this motion as below. Time is an independent variable whereas velocity is dependent on time.



Learners activities 10 min

2.2.1 What is meant by constant acceleration?

2.2.2 A quantum taxi is driving at 13 $m \cdot s^{-1}$ when the traffic officer jumps into the road and ask the driver to pull off. It takes the Taxi 5 s to come to stop. Calculate the **magnitude** of Taxi acceleration.

2.2.3 A boy starts from rest at the stop sign and runs along a straight road. After 5 s he attained the velocity of 6,4 $m \cdot s^{-1}$ .Calculate his acceleration

2.2.4 A loaded 10 ton truck moving at 20 $m \cdot s^{-1}$ is brought to halt gradually and uniformly in 0,5 minute . Calculate :

2.2.4.1 its uniform acceleration

2.2.4.2 distance covered before it stops

Corrections [7 min]

3. Conclusion

Activity to Reinforce lesson(Educator may summarise the main aspects of the lesson).[**5 min**.]

HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]
RESOURCES USED: worksheets, textbooks

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

Possible answers

2.2.1 Constant acceleration is the constant increase in velocity in every specific equal interval

2.2.2 $\vec{a} = \frac{v_f - v_i}{\Delta t}$

$= \frac{0 - 13}{5}$

$= -2{,}6\ m \cdot s^{-2}$

$= 2{,}6\ ms^{-2}$ in opposite direction

2.2.3 $\vec{a} = \frac{v_f - v_i}{\Delta t}$

$= \frac{6{,}4 - 0}{5}$

$= 1{,}28\ m \cdot s^{-2}$ forward

2.2.4.1 $\vec{a} = \frac{v_f - v_i}{\Delta t}$

$= \frac{0 - 20}{30}$

$= -0{,}67$

$= 0{,}67\ m \cdot s^{-2}$ in opposite direction

2.2.4.2 $v = \frac{D}{\Delta t}$

$20 = \frac{D}{30}$

$D = 600\ m$

GRADE	10	SUBJECT	Physical Sciences	WEEK	30	TOPIC	Positive and negative acceleration	Lesson	3

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Demonstrate positive and negative acceleration meanings • Differentiate between positive and negative acceleration		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Demonstration ; observation , question and answer method

2. LESSON DEVELOPMENT

2.1 Introduction

a) PRE-KNOWLEDGE learners need understanding of the following:

(i) acceleration

(ii) Increasing velocity

b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]

QUESTIONS for the **BASELINE ASSESSMENT**

i) Define acceleration

ii) When is an object said to be in constant acceleration?

iii) When is the acceleration of an object positive?

iv) What quantity is represented by the gradient of a velocity time graph?

c) Do corrections

i) Acceleration is the rate of change of velocity

ii) When the velocity is increasing with the same amount in equal time interval

iii) When the final velocity is greater than initial velocity

iv) Gradient of a velocity time graph represents "acceleration"

2.2 Main Body (Lesson presentation) [30 min]

Acceleration ($\vec{a}$) is the rate of change of object's velocity.

The general RULE OF THUMB is: If an object is slowing down, then its acceleration is in the opposite direction of its motion.

This RULE OF THUMB can be applied to determine whether the sign of the acceleration of an object is positive or negative, right or left, up or down, etc. Consider the two data tables below. In each case, the acceleration of the object is in the positive direction.

In Example A, the object is moving in the positive direction (i.e., has a positive velocity) and is speeding up. When an object is speeding up, the acceleration is in the same direction as the velocity. Thus, this object has a **positive acceleration**.

In Example B, the object is moving in the negative direction (i.e., has a negative velocity) and is slowing down. According to our RULE OF THUMB, when an object is slowing down, the acceleration is in the opposite direction as the velocity. Thus, this object also has a **positive acceleration**.

Example A

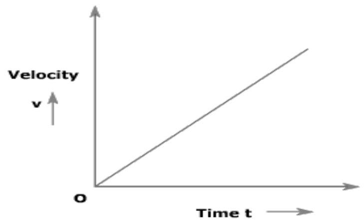
Time (s)	Velocity (m/s)
0	0
1	2
2	4
3	6
4	8

Example B

Time (s)	Velocity (m/s)
0	-8
1	-6
2	-4
3	-2
4	0

These are both examples of positive acceleration.

www. Wikipedia.com



In the examples below:

In each case, the acceleration of the object is in the negative direction. **In Example C**, the object is moving in the positive direction (i.e., has a positive velocity) and is slowing down. In each case, the acceleration of the object is in the negative direction. In **Example C,** the object is moving in the positive direction (i.e., has a positive velocity) and is slowing down. when an object is slowing down, the acceleration is in the apposite direction as the velocity. Thus, this object has a **negative acceleration**.

In Example D, the object is moving in the negative direction (i.e., has a negative velocity) and is speeding up. When an object is speeding up, the acceleration is in the same direction as the velocity. Thus, this object also has a **negative acceleration**.

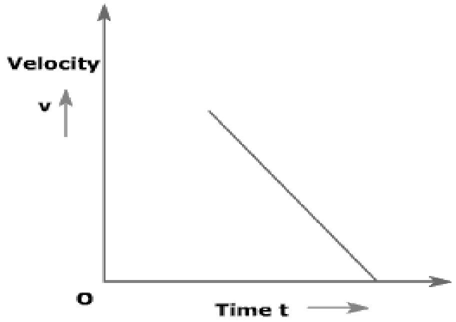
Example C

Time (s)	Velocity (m/s)
0	8
1	6
2	4
3	2
4	0

Example D

Time (s)	Velocity (m/s)
0	0
1	-2
2	-4
3	-6
4	-8

These are both examples of negative acceleration.



www. Wikipedia.com

Learners activities 10 min

2.2.1 An object moving at 10 m·s^{-1} north reaches a velocity of 50 m·s^{-1} in 8 seconds. Calculate the acceleration of the object and indicate whether an object is undergoing positive acceleration or negative acceleration

2.2.2 A motorcycle is riding at 54 m·s^{-1} approaching the traffic lights and the lights turned red. He slams the brakes and stops after 3 seconds. Calculate the acceleration of the motorcycle . Indicate whether it is positive acceleration or negative acceleration

2.2.3 What is the meaning of the answer in 2.2.2?

2.2.4 Draw a velocity-time graph of an object starting to accelerate from a certain positive velocity

2.2.5 A car can accelerate from rest to a speed of 100 km·h^{-1} in a time of 6s.

2.2.5.1 What is the acceleration of the car in these 6 s?

2.2.5.2 If it take only 10 s for the driver to bring the car to halt, calculate the maximum acceleration of the car during braking.

Corrections [7 min]

3. Conclusion

Activity to Re-enforce lesson(Educator may summarise the main aspects of the lesson).[**5 min**.]

HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

RESOURCES USED:

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

Possible Answers

2.2.1 $\vec{a} = \frac{v_f - v_i}{\Delta t}$

$= \frac{50 - 10}{8}$

$= 5\ m \cdot s^{-2}$ forward

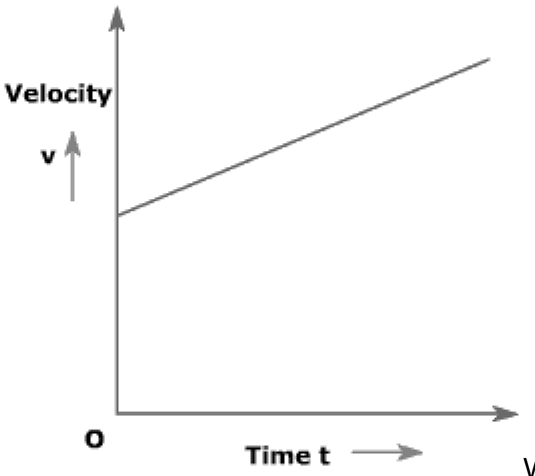
2.2.2 $\vec{a} = \frac{v_f - v_i}{\Delta t}$

$= \frac{0 - 54}{3}$

$= -18\ m \cdot s^{-2} \rightarrow 18\ m \cdot s^{-2}$ in opposite direction

2.2.3 Negative answer indicates the bike is slowing down

2.2.4



Wikipedia.com

2.2.5.1 $a = \frac{v_f - v_i}{\Delta t}$ $100 km \cdot h^{-1} = 100/3.6 \rightarrow 27{,}78\ m.s^{-1}$

$= \frac{27{,}78 - 0}{6}$

$= 4{,}63\ m \cdot s^{-2}$ forward

2.2.5.2 $\vec{a} = \frac{v_f - v_i}{\Delta t}$

$= \frac{0 - 27{,}78}{10}$

$= -2{,}78\ m \cdot s^{-2}$

$= 2{,}78\ m \cdot s^{-2}$ in opposite direction to that of the motion

GRADE	10	SUBJECT	Physical Sciences	WEEK	30	TOPIC	Velocity and acceleration	Lesson	4

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	

LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Communicate information provided by ticker tape (displacement, velocity and acceleration) • Convert between different units

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:
Demonstration ; observation , question and answer method

2. LESSON DEVELOPMENT

2.1 Introduction

a) PRE-KNOWLEDGE learners need understanding of the following:

(i) speed, velocity and acceleration

ii) Vector and scalar quantities

b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]

QUESTIONS for the **BASELINE ASSESSMENT**

i) Classify speed, velocity and acceleration as scalar or vector quantity

ii) Define velocity and acceleration

iii) Describe what information is provided by the acceleration

c) Do corrections

i) Speed is a scalar, velocity is a vector quantities

ii) velocity is the rate of change of object's displacement and acceleration is the rate at which velocity changes

iii) Acceleration indicates how the velocity changes, but does not indicate the direction.

2.2 Main Body (Lesson presentation) [30 min]

Experiment

Ten ticks → 11 dots, $T = 1/f$, $t = n \times T$, Convert 1 hour into seconds, 12 km into m, 15 cm into m

Apparatus / Materials

Trolley, Elastic cords for accelerating trolley, Rod for attaching elastic cord to trolley, Ticker-timer with power supply unit, Ticker-tape and

Sellotape

Procedure

a) Thread a length of ticker-tape through a ticker-timer and attach the end to a trolley.

b) Pull a trolley with a fixed force along a bench. Loop one end of the elastic cord around a rod attached to the trolley. Keep the force constant by making sure that the cord is always stretched by the same amount as the trolley moves. **Practice doing this**.

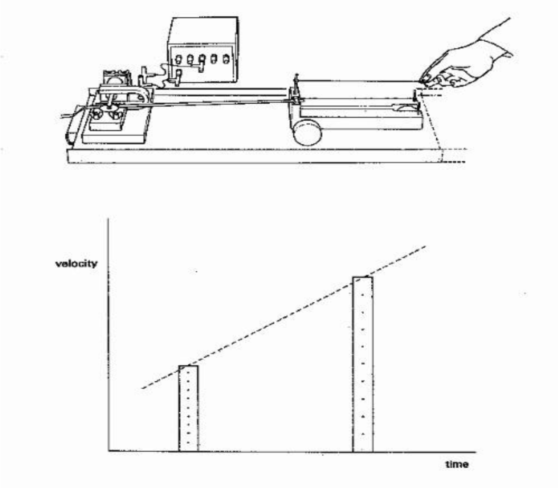
c) Choose and mark through a dot near to the start of the tape. The dots are far enough apart to clearly distinguish one from another.

d) Count ten dot-to-dot spaces and cut the tape, through a dot, again. You have cut a 'ten-tick-tape'.

e) Count 40 more dot-to-dot spaces along the tape. Then cut the next 10 dot-to-dot spaces to make another ten-tick-tape.

f) Draw a horizontal line, as a time axis, on a piece of paper. Glue your tapes, vertically and 10 centimetres apart, so the bottom of each tape touches this axis. This 10 centimetres represents 1 second.

www. Wikipedia.com



g) Draw a vertical axis anywhere to the left of the first tape. This is a velocity axis.

h)Mark a scale, in metres per second, on your vertical axis. Each vertical centimetre on your axis represents 0,05 metres per second.

i)Use your velocity axis to help you to work out the first velocity and the second velocity. You can call these v_i and v_f.
Work out the average acceleration of your trolley during the time between the two tapes. Acceleration is 'rate of change of velocity'. It is equal to the change in velocity divided by the time. *Average acceleration = change in velocity/time taken.*

The change in velocity is the difference between the two velocities, $v_f - v_i$. The time between these two tapes is *t*, which in this case is 1 second.

j) Draw a straight line between the centres of the tops of the tapes. Draw a horizontal line from the centre of the top of the first tape. Draw a vertical line through the top of the second tape. You have made a right-angled triangle. The length of the base of your triangle, using the units of the horizontal axis, is 1 second.

k)Find the gradient of the line connecting the tops of the two tapes. Measure the height of the triangle, using the units of the velocity axis, which are metres per second ($m \cdot s^{-1}$). Divide the height of the triangle, in metres per second, by the base, in seconds. This gives you the average acceleration in metres per second per second ($m \cdot s^{-1}$).

Information from a ticker tape: movement of the object (see the arrow), equally spaced dots indicate constant velocity, dots starting closer and ending far apart indicate constant positive acceleration, distance between dots decreasing indicate negative acceleration

Typical results

Time Interval	Total time (t) (s)	Time Change (s)	Total Displacement (m)	Displacement Change (m)	Velocity V ($m.s^{-1}$)
	t	Δt	(x)	Δx	$V=\frac{\Delta x}{\Delta t}$
0	0.00	0.00	0.00		
1	0.20	0.20	0.32	0.32	1.60
2	0.40	0.20	0.65	0.33	1.65
3	0.60	0.20	0.97	0.32	1.60
4	0.80	0.20	1.28	0.31	1.55

Analysis of results

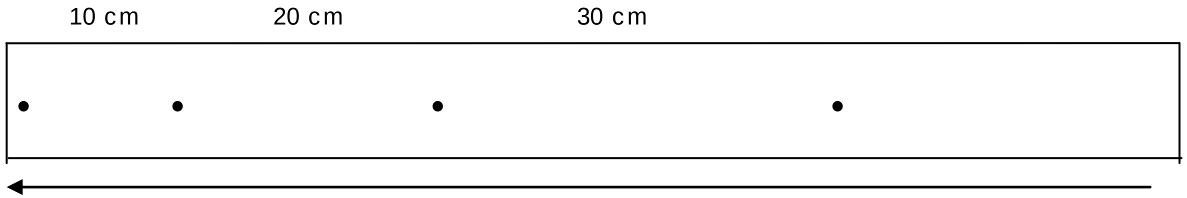
Complete the two columns on the table and draw the velocity time graph, and acceleration time graph

Conclusion : Draw conclusion from the results obtained

5	1.00	0.20	1.60	0.32	1.60
6	1.20	0.20	1.91	0.31	1.55
7	1.40	0.20	2.24	0.33	1.65

Learners activities 10 min

Given that the frequency of the ticker timer is 50 Hz and the piece of the tape of a moving trolley as shown in the sketch below:

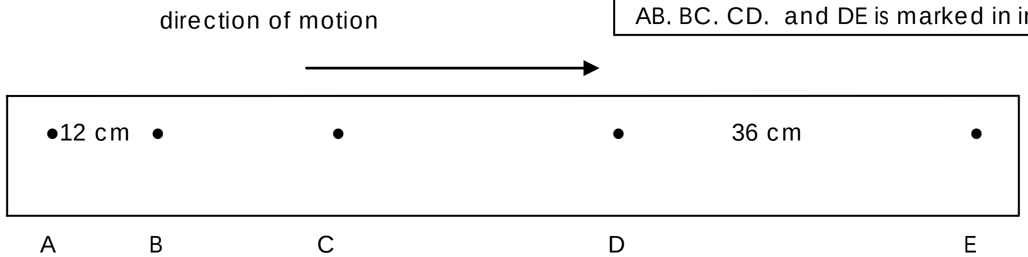


2.2.1 Calculate the average velocity of the first interval

2.2.2 The average velocity of the third interval

2.2.3 The acceleration of the trolley

A ticker timer is used during an experiment to determine the acceleration of a trolley as in the diagram below. The period of a ticker timer is 0,02 s. The following part that was attached to attached to the trolley was obtained. The trolley initially moved eastwards. Each of the intervals AB. BC. CD. and DE is marked in intervals of **10 dots**



2.2.4 Calculate the velocity in the intervals AB and DE

2.2.5 Calculate the acceleration of the trolley over AE

2.2.6 What information does the acceleration provide?

Corrections [7 min]

3. Conclusion

Activity to Re-enforce lesson(Educator may summarise the main aspects of the lesson).[**5 min**.]

HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

RESOURCES USED: chalkboard, worksheets, ticker timer and tape, power supply**(**battery), retort stand, ruler,

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

Possible Answers

2.2.1 $\bar{v} = \frac{\Delta x}{\Delta t}$

$= \frac{0,1}{0,02}$

= 5 **m.s^{-1} to the left**

2.2.2 $\bar{v} = \frac{\Delta x}{\Delta t}$

$= \frac{0,3}{0,02}$

= 15 **m.s^{-1} to the left**

2.2.3 $\bar{a} = \frac{\Delta v}{\Delta t}$

$= \frac{15-5}{0,04}$

= 250 **m·s^{-2} left**

2.2.4 $\bar{v}_{(AB)} = \frac{\Delta x}{\Delta t}$

$= \frac{0.12}{0.2}$

= 0,6 **m.s^{-1} to the right**

$\bar{v}_{(DE)} = \frac{\Delta x}{\Delta t}$

$= \frac{0,36}{0,2}$

= 1,8 **m.s^{-1} to the right**

2 .2.5 $\bar{a} = \frac{\Delta v}{\Delta t}$

$= \frac{1,8 - 0,6}{0,7 - 0,1}$

= 2 **m·s^{-2} to the right**

GRADE	10	SUBJECT	Physical Sciences	WEEK	31	TOPIC	Instantaneous velocity	Lesson	1

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Define instantaneous velocity • Demonstrate understanding of instantaneous velocity by determining velocity at a point		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Demonstration ; observation , question and answer method

2. LESSON DEVELOPMENT

2.1 Introduction

a) PRE-KNOWLEDGE learners need understanding of the following:

(i) Average velocity

ii) Increasing velocity

b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]

QUESTIONS for the **BASELINE ASSESSMENT**

i) What is the average velocity in an interval called?

ii) What is meant by instantaneous velocity ?

iii) Which quantity is represented by gradient of displacement time graph?

c) Do corrections with the learners

i) Average velocity is the change of the object's position over a specified time period (is the total displacement divided by the total time.)

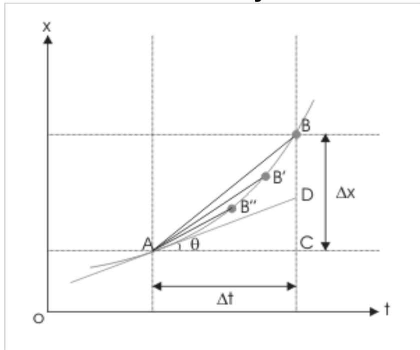
ii) Instantaneous velocity is the velocity within a short period of time (at a time)

iii) Velocity

2.2 Main Body (Lesson presentation) [30 min]

Instantaneous velocity is the velocity of an object at an instant. Instantaneous velocity is the rate of change of displacement at any given time. Displacement is a vector quantity, and therefore instantaneous velocity is a vector quantity.

Instantaneous Velocity



In the figure above, as we proceed from point B to A through intermediate points B' and B'', the time interval becomes smaller and smaller and the chord becomes tangent to the curve at point A as $\Delta t \rightarrow 0$. The magnitude of instantaneous velocity (speed) at A is given by the slope of the curve. To obtain the instantaneous velocity, that is, the velocity at one instant (one point in time -- say t_1), take the slope of the tangent line that touches the curve at that point.

V_{inst} = slope of tangent

$$V_{inst} = \frac{d_2 - d_1}{t_2 - t_1}$$

There is one important difference between average velocity and instantaneous velocity. The magnitude of average velocity and average speed may **not be equal**, but magnitude of instantaneous velocity is always equal to instantaneous speed.

Magnitude of displacement and distance are different quantities. The magnitude of displacement is a measure of linear shortest distance, whereas distance is measure of actual path. Therefore, magnitude of average velocity and average speed are not be equal unless it is on a straight line.

However, if the motion is along a straight line and without any change in direction (i.e unidirectional), then distance and displacement are equal and so magnitude of average velocity and average speed are equal.

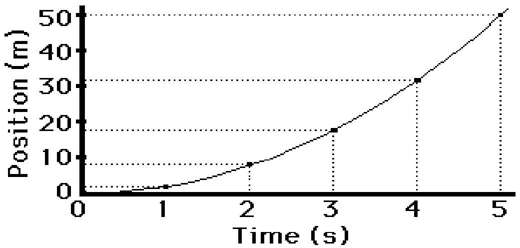
In the case of instantaneous velocity, the time interval is infinitesimally small for which displacement and distance are infinitesimally small. In such situation, both displacement and distance are same. Hence, magnitude of instantaneous velocity is always equal to instantaneous speed.

Learners activities 10 min

2.2.1 What is meant by instantaneous velocity?

2.2.2 How is instantaneous velocity calculated from the displacement –time graph?

2.2.3



2.2.3.1 From the graph above, calculate the average velocity between t= 2s and t = 4s?

2.2.3.2 Calculate the instantaneous velocity at t= 4,5 s

2.2.5 What is the difference between the average velocity and the instantaneous velocity?

Corrections [7 min]

3. Conclusion

Activity to Re-enforce lesson (Educator may summarise the main aspects of the lesson).[**5 min**.]

HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

RESOURCES USED:

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	31	TOPIC	Instantaneous speed	Lesson	2

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Define instantaneous speed • Convert between different units		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Demonstration ; observation , question and answer method

2. LESSON DEVELOPMENT

2.1 Introduction

a) PRE-KNOWLEDGE learners need understanding of the following:

(i) Average speed

(ii) Increasing velocity

b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]

QUESTIONS for the **BASELINE ASSESSMENT**

i) What is the average speed in the middle of an interval called?

ii) What is meant by instantaneous speed ?

iii) Which quantity is represented by gradient of distance - time graph?

c) Do corrections

i) Instantaneous Speed

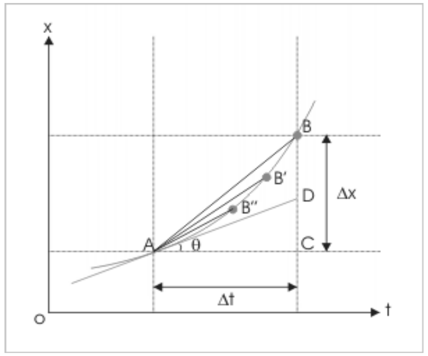
ii) is the magnitude of instantaneous velocity (velocity within a short space of time

iii) speed

2.2 Main Body (Lesson presentation) [30 min]

Instantaneous speed is the speed of an object at an instant (within a short period of time). Instantaneous speed is the magnitude of instantaneous velocity (the change in distance at any given time). It is a scalar quantity. It has magnitude, but no direction.

Instantaneous speed



In the figure on the left, as we proceed from point B to A through intermediate points B' and B'', the time interval becomes smaller and smaller and the chord becomes tangent to the curve at point A as $\Delta t \rightarrow 0$. The magnitude of instantaneous velocity (speed) at A is given by the slope of the curve. To obtain the instantaneous speed, that is, the velocity at one instant (one point in time -- say t_1), take the slope of the tangent line that touches the curve at that point.

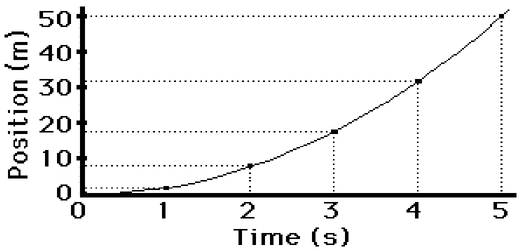
If an object is travelling at a constant speed, then instantaneous speed and average speed are the same. The speed that is registered on traffic officers camera is the average speed within a short period of time, and is considered the instantaneous speed since the time is too short that it is closer to zero second.

Learners activities 10 min

2.2.1 What is meant by instantaneous speed? And how does it differ with instantaneous velocity?

2.2.2 What is the difference between the average speed and the instantaneous speed?

2.2.3 How can instantaneous speed calculated from the distance –time graph?



2.2.3.1 From the graph , calculate the average velocity between t= 2s and t = 4s?

2.2.3.2 Calculate the instantaneous speed at t= 3 s

2.2 When the car's speed recorded on the speedometer reads 90 km/h, is that average speed or instantaneous speed? Give a reason for your answer.

Corrections [7 min]

3. Conclusion

Activity to Re-enforce lesson(Educator may summarise the main aspects of the lesson).[**5 min**.]

HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

RESOURCES USED: chalkboard, worksheets, ticker timer and tape, power supply**(**battery), retort stand, ruler,

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	31	TOPIC	Uniform velocity and uniformly accelerated	Lesson	3

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Describe and distinguish between uniform velocity and uniformly accelerated motion • Describe the motion of an object given a graph of motion (velocity-time, position-time and acceleration time graphs)		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Demonstration ; observation , question and answer method

2. LESSON DEVELOPMENT

2.1 Introduction

a) PRE-KNOWLEDGE learners need understanding of the following:

(i) constant velocity

ii) uniform acceleration

b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]

QUESTIONS for the **BASELINE ASSESSMENT**

i) When does an object move at constant velocity?

ii) What is meant by uniform acceleration

iii) What will be the acceleration if the object is moving at constant velocity ?

c) Do corrections

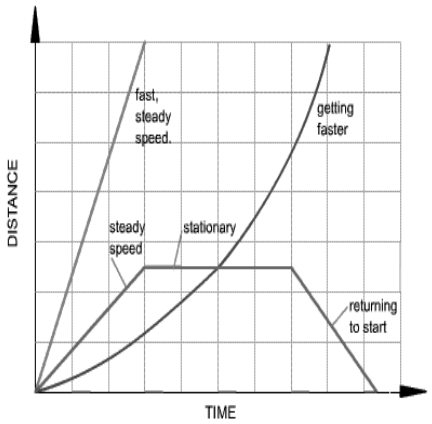
i) If it covers equal distances at equal time intervals

ii) velocity is changing with equal amounts at equal time intervals

iii) Zero

2.2 Main Body (Lesson presentation) [30 min]

Position – time graph



Distance-time graphs
www.wikipedia.com

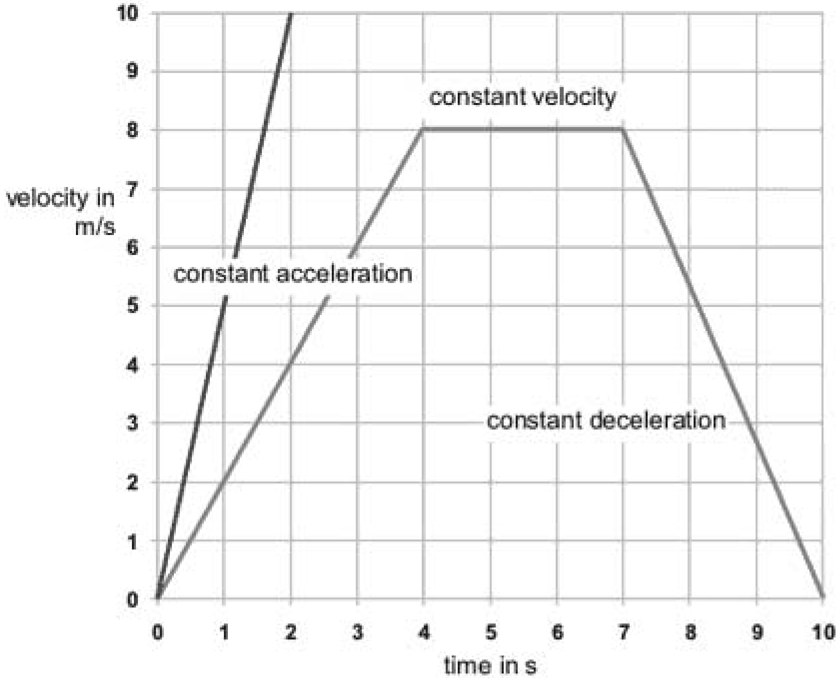
The specific features of the motion of objects are demonstrated by the shape and the slope of the lines on a position vs. time graph. Refer to the colour and the shapes on the graphs above.

The gradient of a line on a distance-time graph represents the speed of the object.

The **velocity** of an object is its **speed** in a particular **direction**. This means that two cars travelling at the same speed, but in opposite directions, have different velocities. One velocity will be **positive**, and the velocity in the other direction will be **negative**.

Features of the graphs

When an object is moving with a constant velocity, the line on the graph is horizontal. When an object is moving with a steadily increasing velocity, or a steadily decreasing velocity, the line on the graph is straight, but sloped. The diagram shows some typical lines on a velocity-time graph.



velocity - time graph

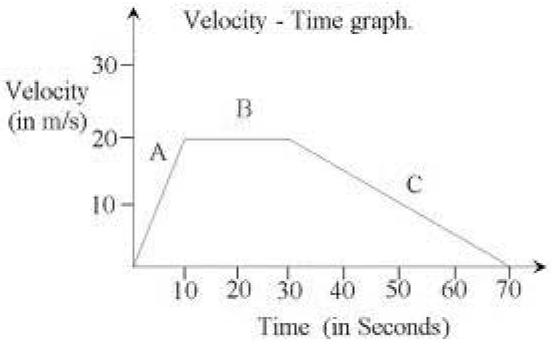
Velocity time graph

The steeper the line, the more rapidly the velocity of the object is changing. The blue line is steeper than the red line because it represents an object that is increasing in velocity much more quickly than the one represented by the red line.

Notice that the part of the red line between 7 and 10 seconds is a line sloping downwards (with a negative gradient). This represents an object that is steadily slowing down.

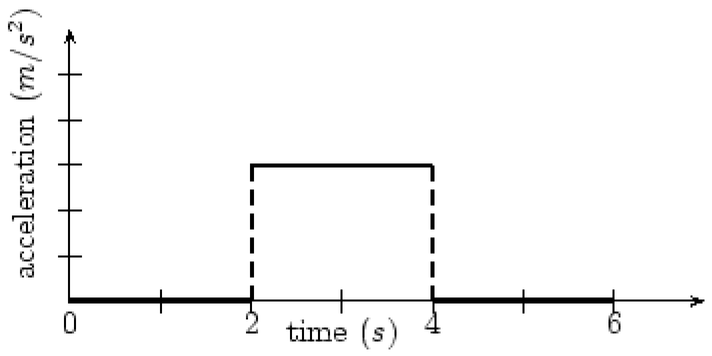
Learners activities 10 min

2.2.1.Describe the motion of an object in each time interval on the diagram below:

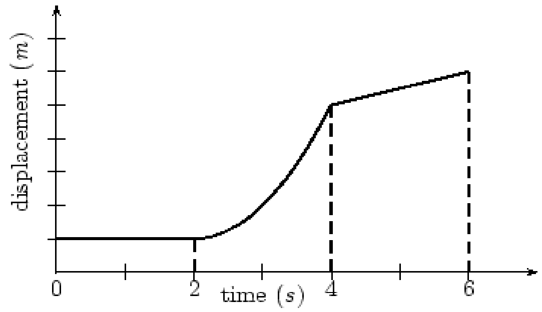


2.2.2 Describe the motion of an object using the given graph below

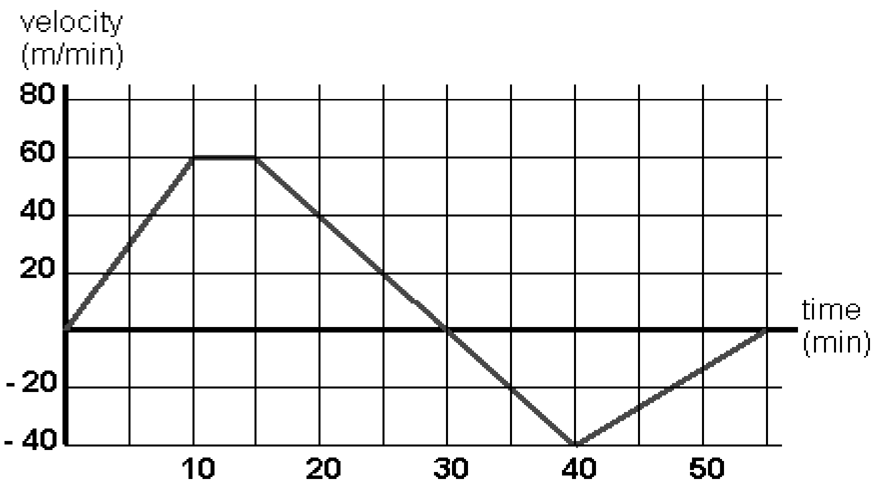
2.2.3 Draw the rough sketch to indicate the change in velocity for the entire motion in the 6 seconds interval



2.2.4 Given the displacement-time graph below, draw the corresponding velocity-time and acceleration-time graphs, and then describe the motion of the object.



A



B

2.2.5 Describe the motion of an object in graph B for the entire 60 minutes interval

3. Conclusion

Activity to Re-enforce lesson(Educator may summarise the main aspects of the lesson).[**5 min**.]

HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

RESOURCES USED: chalkboard, worksheets, ticker timer and tape, power supply**(**battery), retort stand, ruler,

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	31	TOPIC	Position –time graph and velocity - Time: 60 min	Lesson	4

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Determine the velocity of an object from gradient of position-time graph		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Demonstration ; observation , question and answer method

2. LESSON DEVELOPMENT

2.1 Introduction

a) PRE-KNOWLEDGE learners need understanding of the following:

(i) position-time graph

(ii) gradient of a slope

b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]

QUESTIONS for the **BASELINE ASSESSMENT**

i) In a position – time graph, which variable is independent?

ii) What is the slope of a position time graph called?

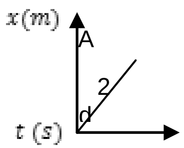
iii) Draw shape of a position-time graph that shows a steady increase in velocity

c) Do corrections

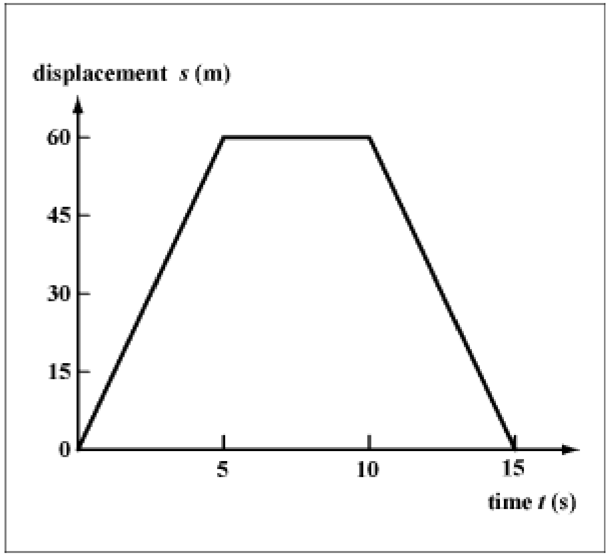
i) time

ii) velocity

iii)



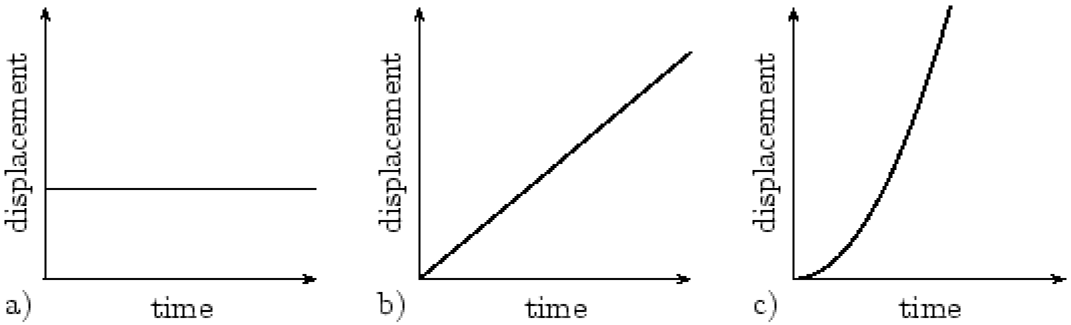
2.2 Main Body (Lesson presentation) [30 min]



$v = \frac{\Delta x}{\Delta t}$ or $\frac{\Delta s}{\Delta t}$

The slope of a displacement-time graph gives velocity

The slope is the same all the way from A to C, so the cyclist's velocity is constant over the entire displacement he travels. Below are examples of the displacement-time graphs you will encounter.



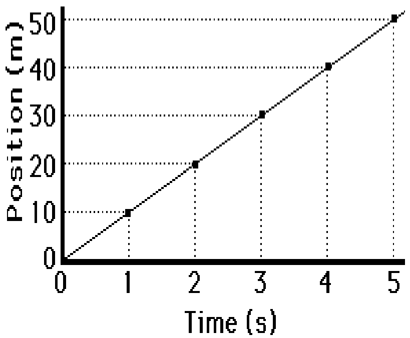
a) shows the graph for an object stationary over a period of time. The gradient is zero, so the object has zero velocity.

b) shows the graph for an object moving at a constant velocity. You can see that the displacement is increasing as time goes on. The gradient, however, stays constant (remember: its the slope of a straight line), so the velocity is constant. Here the gradient is positive, so the object is moving in the direction we have defined as positive.

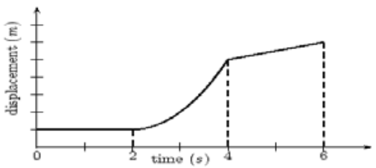
c) shows the graph for an object moving at a constant acceleration. You can see that both the displacement and the velocity (gradient of the graph) increase with time. The gradient is increasing with time, thus the velocity is increasing with time and the object is accelerating.

Learners activities 10 min

consider the position versus time graph below.



2.2.6 Given the displacement-time graph below:



Wikibooks.org

Corrections [7 min]

3. Conclusion

Activity to Re-enforce lesson(Educator may summarise the main aspects of the lesson).[**5 min**.]

HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

RESOURCES USED: chalkboard, worksheets, ticker timer and tape, power supply**(**battery), retort stand, ruler,

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	32	TOPIC	Slope of Gradient at a point (position-time graph)	Lesson	1

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Determine the tangent to the slope of a position- time graph • Describe the tangent to the slope –instantaneous velocity		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:
Demonstration ; observation , question and answer method

2. LESSON DEVELOPMENT
2.1 Introduction

a) PRE-KNOWLEDGE learners need understanding of the following:
(i) speed and velocity
ii) Gradient of a graph and a tangent at a point

b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]

QUESTIONS for the **BASELINE ASSESSMENT**

i) Draw a rough sketch of position-time graph for uniform positive velocity
ii) Write an equation to calculate the gradient of a slope in a position- time graph
iii) Which quantity is represented by the slope of a position- time graph?
iv) What does the tangent to the slope at a point represent?

c) **Do corrections**

i) 

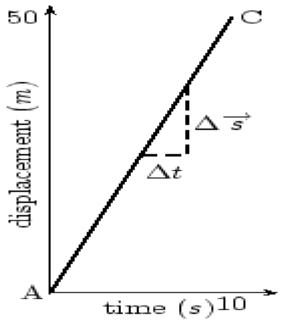
(ii) The gradient of this graph is $= \frac{\text{change in displacement}}{\text{change in time}}$

iii) velocity

iv) Instantaneous velocity

2.2 Main Body (Lesson presentation) [30 min]

Instantaneous velocity (speed) is the velocity within a short period of time. In this case, it is calculated by finding the tangent to a slope at a point. The tangent to a slope will be the same if the position-time graph is a straight line and the instantaneous velocity is the same as the average velocity. Below is a graph showing the displacement of the cyclist from A to C:

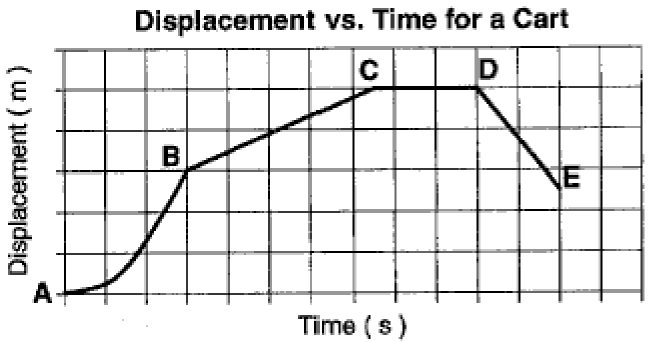


This graph shows how, in 10 seconds time, the cyclist has moved from A to C. We know the gradient (slope) of a graph is defined as the change in y divided by the change in x, i.e. $\frac{\Delta y}{\Delta x}$

At any stage between A and C the velocity will be constant, and the instantaneous velocity is the same as the average velocity

Learners activities 10 min

2.2.1 From the given graph below



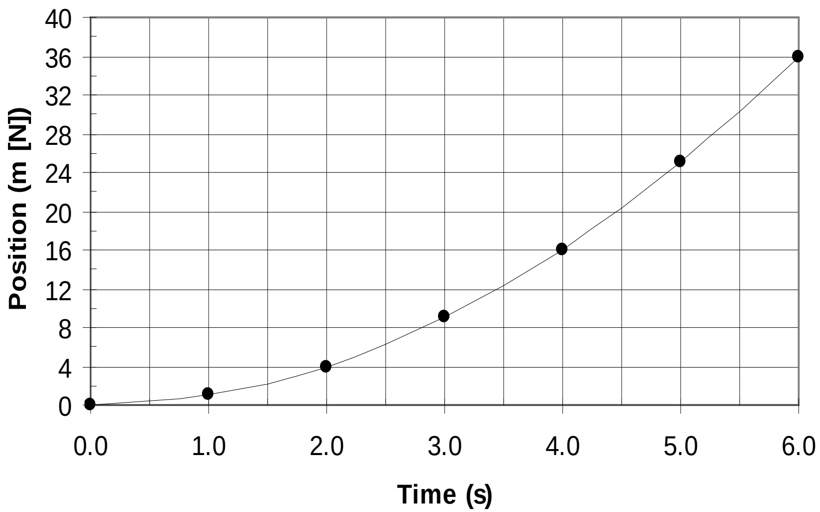
a) Find the gradient of the graph at each interval if each square has dimensions 1 m and 1 s

b) Draw the velocity time graph for this motion

c) Describe the motion in words from A to E

d) What is the velocity between C and D

2.2.2 Study this position-time graph below.

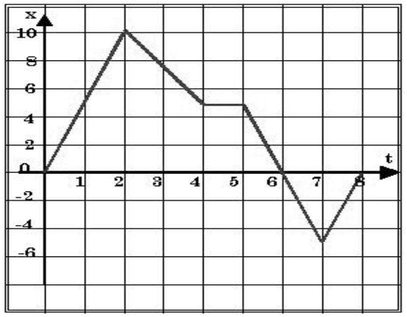


a) Draw tangents on the position-time graph for at least 4 time points,

b) Calculate the slopes of these tangents to find the instantaneous velocities

c) plot them on a velocity-time graph, and draw a best-fit straight line.

2.2.3 Find the instantaneous velocity of the particle described in the figure at the following times: (a) t = 1.0 s, (b) t = 3.0 s, (c) t = 4.5 s, and (d) t = 7.5 s.



Corrections [7 min]

3. Conclusion

Activity to Re-enforce lesson(Educator may summarise the main aspects of the lesson).[**5 min**.]

HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

RESOURCES USED: chalkboard, worksheets, ticker timer and tape, power supply**(**battery), retort stand, ruler,

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	32	TOPIC	Gradient of velocity-time graph - Time: 60 min	Lesson	2

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Determine the acceleration from the gradient of a velocity-time graph • Draw the acceleration time graph		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Demonstration ; observation , question and answer method

2. LESSON DEVELOPMENT

2.1 Introduction

a) PRE-KNOWLEDGE learners need understanding of the following:

(i) speed, velocity and acceleration

(ii) Vector and scalar quantities

b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]

QUESTIONS for the **BASELINE ASSESSMENT**

i) Classify speed, velocity and acceleration as scalar or vector quantity

ii) Define velocity and acceleration

iii) Describe what information is provided by the acceleration

> a) shows the graph for an object moving at a constant velocity over a period of time. The gradient is zero, so the object is not accelerating. b) shows the graph for an object which is decelerating. Velocity is decreasing with time. The gradient, however, stays constant (remember: its the slope of a straight line), so the acceleration is constant. Here the gradient is negative, so the object is accelerating in the opposite direction to its motion, hence it is decelerating.

c) Do corrections

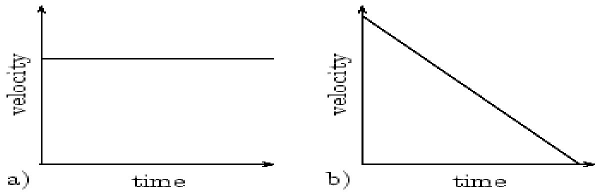
i) Speed is a scalar, velocity is a vector quantities

ii) velocity is the rate of change of object's displacement and acceleration is the rate at which velocity changes

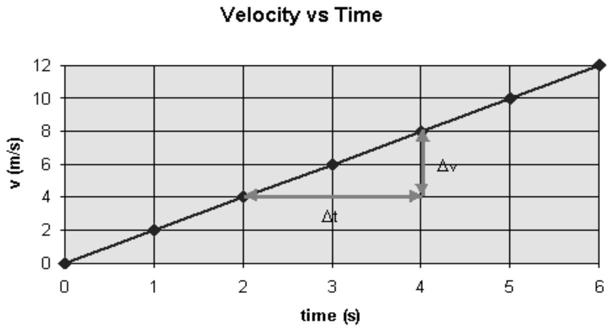
iii) Acceleration indicates how the velocity changes, but does not indicate the direction.

2.2 Main Body (Lesson presentation) [30 min]

The slope of the graph is given by $a = \frac{\Delta v}{\Delta t} = \frac{v_2 - v_1}{t_2 - t_1}$. The slope can either be positive or negative.



A uniformly accelerated motion is represented by the velocity - time graph below.



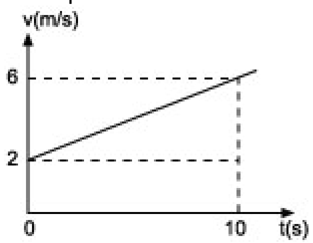
www.wikipedia.com

The gradient of this graph is $\frac{\Delta \vec{v}}{\Delta t}$ and that gradient is also known as acceleration

$$a = \frac{\Delta v}{\Delta t} = \frac{v_2 - v_1}{t_2 - t_1}$$

For motion with constant acceleration in one dimension the velocity versus time graph is a straight line. The slope of this straight line yields a_x. The **acceleration versus time graph** yields a straight line with zero slope.

Example



Determine: the average acceleration in the 10 s interval

Answer:

Based on the graph:

$v_i = 2\ m{\cdot}s^{-1}$

$v_f = 6\ m{\cdot}s^{-1}$

$t = 10\ m{\cdot}s^{-1}$

thus, the average acceleration: $a = \frac{v_t - v_o}{t}$

a = (6-2) / 10

$a = 0.4\ m/s^2$

From the graph, the slope of the graph is given by :

$$a = \frac{\Delta v}{\Delta t} = \frac{v_2 - v_1}{t_2 - t_1}$$

Learners activities 10 min

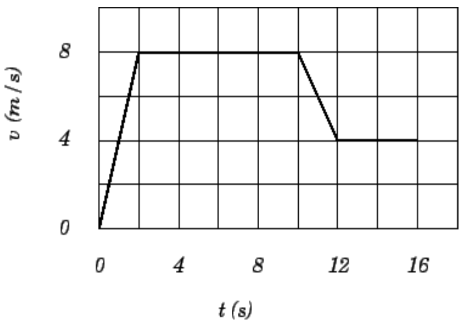
2.2.1 Consider the motion of the object whose velocity-time graph is given in the diagram below.

a) What is the acceleration of the object between times $t = 0$and $t = 2$?

b) What is the acceleration of the object between times $t = 10$and $t = 12$?

c) Describe the motion of an object between t = 2 s and t = 10 s

d) Draw the acceleration –time graph for the motion.



a) Determine the acceleration in the first four seconds

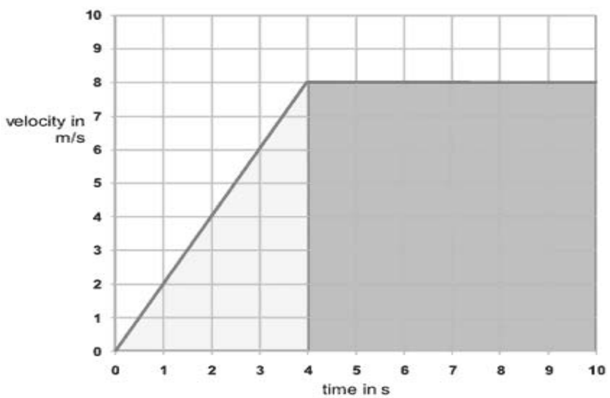
b) What kind of acceleration is experienced in the first four seconds?

c) Calculate acceleration in the last six seconds

d) What kind of acceleration is experienced in the last six seconds?

e) Draw an acceleration –time graph for the entire motion

2.2.2 Study this velocity-time graph below.



Corrections [7 min]

3. Conclusion

Activity to Re-enforce lesson(Educator may summarise the main aspects of the lesson).[**5 min**.]

HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

RESOURCES USED: chalkboard, worksheets

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	32	TOPIC	Area under velocity-time graph	Lesson	3

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	

LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Determine the area under the velocity- time graph • Relate the area of a graph to displacement

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:

Demonstration ; observation , question and answer method

2. LESSON DEVELOPMENT

2.1 Introduction

a) PRE-KNOWLEDGE learners need understanding of the following:

(i) geometrical figures

(ii) Area of triangle, rectangle and trapezium

b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]

QUESTIONS for the **BASELINE ASSESSMENT**

i) Give the formula for calculating area of a triangle

ii) A rectangle has dimensions 3 m and 2 m respectively. Calculate its area.

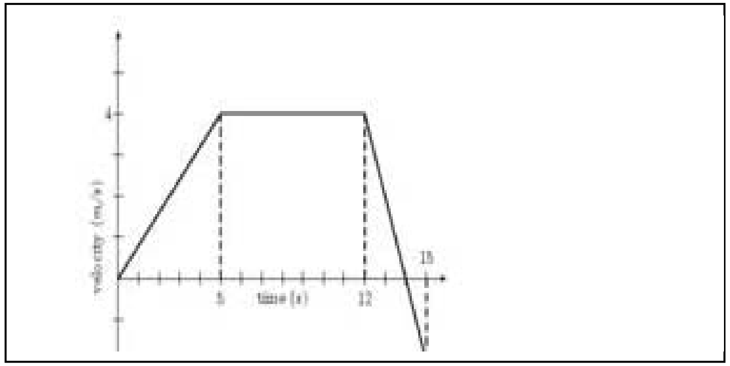
iii) What quantity is calculated from the area of a velocity-time graph? Give its unit of measurement.

c) Do corrections

i) Area (A) = ½ bh

ii) Area (A) = l x b

iii) displacement, it is measured in metres (m)



2.2 Main Body (Lesson presentation) [30 min]

To calculate displacement, the following equations are important :

Area (A) of = ½ bh △

Area (A) ▭ = l x b

Area of trapezium = ½ (sum of parallel sides) x perpendicular height or divide the figure Into triangles and rectangles

The velocity-time graph of a car is plotted on the right of these notes.

Calculate the displacement of the car after 15 seconds.

solution

For t = 0s to t = 5s this is the triangle on the left:

$$\begin{aligned} Area\triangle &= \tfrac{1}{2}b \times h \\ &= \tfrac{1}{2}5s \times 4m/s \\ &= 10m \end{aligned}$$

For t = 5s to t = 12s the displacement is equal to the area of the rectangle

$$\begin{aligned} Area\square &= w \times h \\ &= 7s \times 4m/s \\ &= 28m \end{aligned}$$

For t = 12s to t = 14s the displacement is equal to the area of the triangle above the time axis on the right

$$\begin{aligned} Area\triangle &= \tfrac{1}{2}b \times h \\ &= \tfrac{1}{2}2s \times 4m/s \\ &= 4m \end{aligned}$$

Learners activities 10 min

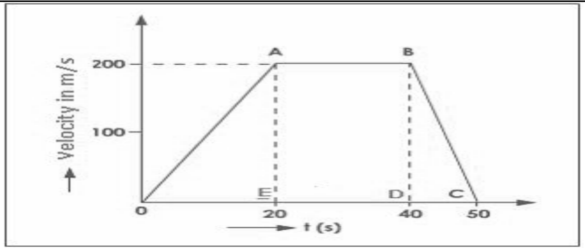
2.2.1 Figure shows a velocity - time graph of a body starting from rest. Study the graph and answer the following questions:

(a) Describe the journey along OA, AB, BC.

(b) Calculate the displacement during the first 40 seconds.

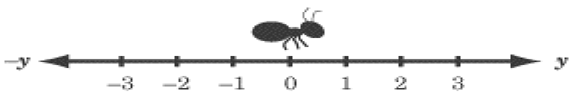
(c) How long does the body has zero acceleration for?

(d) Calculate the distance travelled during the journey

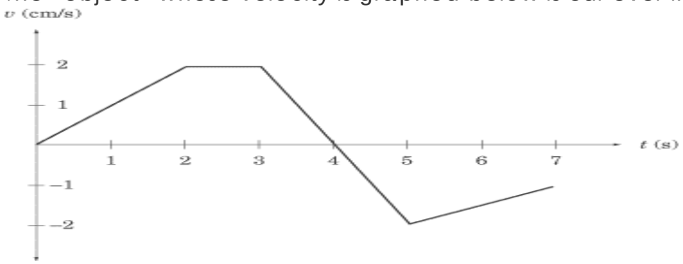


www.wikibooks .org

2.2.2 In the question that follows, we will examine the movement of an ant running back and forth along a line.



The "object" whose velocity is graphed below is our ever-industrious ant, a little later in the day. Determine the displacement of the ant after 7 s



Corrections [7 min]

3. Conclusion

Activity to Re-enforce lesson(Educator may summarise the main aspects of the lesson).[**5 min**.]

HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

RESOURCES USED: chalkboard, worksheets

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	

GRADE	10	SUBJECT	Physical Sciences	WEEK	32	TOPIC	Equations of motion (Kinematics) - Time: 60 min	Lesson	4

LESSON SUMMARY FOR: DATE STARTED:		DATE COMPLETED:	
LESSON OBJECTIVES	At the end of the lesson learners should be able to: • Solve problems using equations of motion • Demonstrate understanding of safety issues with regard to vehicles		

TEACHING and LEARNING ACTIVITIES

1. TEACHING METHOD/S USED IN THIS LESSON:
Demonstration ; observation , question and answer method

2. LESSON DEVELOPMENT
2.1 Introduction

a) PRE-KNOWLEDGE learners need understanding of the following:
(i) speed, velocity and acceleration
ii) Vector and scalar quantities
b) BASELINE ASSESSMENT (educator to design a worksheet/ transparency or write questions on the board [preferably a worksheet to save time] to gauge the learners memory of their relevant prior knowledge) [5 min]
QUESTIONS for the **BASELINE ASSESSMENT**

i) Write the symbols for velocity, speed, distance, displacement, time and acceleration and the symbols of units of measurements

ii) Define velocity and acceleration

iii) What is the difference between average velocity and instantaneous velocity?

c) Do corrections

i) $\vec{v}$ in m·s^{-1}, **v** in m·s^{-1} , **D** in m, $\vec{x}$ in m, **t** and **a** in m·s^{-2}

ii) velocity is the rate of change of object's displacement and acceleration is the rate at which velocity changes

iii) Instantaneous velocity is the velocity within a short space of time and average velocity is the change of the object's position over a specified time period (is the total displacement divided by the total time.)

2.2 Main Body (Lesson presentation) [30 min]

Word problems in kinematics can be solved using equations of motion as listed below, provided the acceleration is constant or zero and along a straight line:

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ or/*of* $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$ or/*of* $v_f^2 = v_i^2 + 2a\Delta y$	$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ or/*of* $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$

Where v_f is final velocity in $m \cdot s^{-1}$
v_i is initial velocity in $m \cdot s^{-1}$
a is the acceleration in $m \cdot s^{-2}$
t is the time in seconds (s)
and x is the displacement in metres (m)

To solve problems, identify given data, what has to be calculated, and choose the relevant equation. (sometimes check the three given quantities, and required quantity, they will guide you to choose relevant equation). For vector quantities, choose one direction as positive and the opposite side will be negative. It is important to convert quantities to their standard units of measurement.

Hint to solve word problems :

- Transcribe equation from the data sheet into exercise book
- Substitute the values in the equation without rearranging terms
- Use the calculator and write the answer with a unit. For vectors, direction must be included.

Example

A tourist driving his car at 120 km h^{-1} west in Northwest sees three donkeys in the middle of the road when he was 200 m away and applies the brakes to avoid knocking them down.

1.1 Calculate his acceleration.

1.2 The time that it will take him to come to stop.

<u>Solutions</u>

1.1. v_i = 120/3.6 $v_f = 0\ m \cdot s^{-1}$ Δt = ?
= 33,33 $m \cdot s^{-1}$ Δx = 200 m a = ?
$v_f^2 = v_i^2 + 2a\Delta x$
$0^2 = 33{,}33^2 + 2\,(a)(200)$
a = -2, 78 $m \cdot s^{-2}$
= 2, 78 $m \cdot s^{-2}$ east

1.2 a = -2,78 $m \cdot s^{-2}$
Any equation with t can be used
$v_f = v_i + a\Delta t$
0 = 33,33 + (-2,78) Δt
Δt = 11,99 s

Learners activities 10 min

A truck accelerates from rest with a constant acceleration over a distance of 400 m until it attains a velocity of 40 $m \cdot s^{-1}$.

2.2.1 Calculate the magnitude of acceleration of the truck

2.2.2. How long does it take the truck to cover the distance of 400 m ?

A motorcyclist starts from rest at the traffic lights and accelerates at 3 $m \cdot s^{-2}$.

2.2.3 Calculate the velocity of the cyclist after 6 s.

2.2.4 Calculate the distance travelled by the motorcyclist in 6s

2.2.5 Calculate the average velocity during the first 6 s

2.2.6 How far from the traffic lights will the cyclist be, by the time he reaches a velocity of 36 $m \cdot s^{-1}$?

2.2.7 A car was travelling at a speed of 70km/h, the driver saw a rabbit on the road and slammed on the breaks. After 6.0 seconds the car came to a halt, how far did the car travel from the point where the brakes were first applied to the point where the car stopped?

Corrections [7 min]

3. Conclusion

Activity to Re-enforce lesson(Educator may summarise the main aspects of the lesson).[**5 min**.]

HOMEWORK QUESTIONS/ ACTIVITY (educator must give learners a few questions to answer at home by either writing them on the chalkboard or giving an exercise from the prescribed textbook) [30 min]

Speed and Safety :

In order to avoid accidents from happening, drivers need to react quickly to apply the brakes. Stopping distance depends on thinking distance and the braking distance. List five (5) factors affecting the thinking distance and the results of those factors, and five (5) factors affecting the braking distance together with the results of those factors. How should the stopping distance be calculated?

RESOURCES USED: chalkboard, worksheets, ticker timer and tape, power supply**(**battery), retort stand, ruler,

Reflection/Notes:

Name of Teacher		**HOD:**	
Sign:		**Sign:**	
Date:		**Date:**	