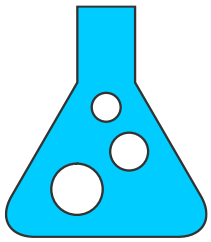
TELEMATIC SCHOOLS PROJECT

2023 SUBJECT WORKBOOK
Grade 11



PHYSICAL SCIENCES

A joint initiative between the Western Cape Education Department and Stellenbosch University.

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BROADCAST SESSIONS

Session	Date	Time	Topic
1	**24/04/2023**	**15h00-16h00**	**Electromagnetism**
2	21/08/2023	16h00-17h00	Energy and Change
3	**16/10/2023**	**15h00-16h00**	**Types of Reactions**

INTRODUCTION AND TOPICS

INTRODUCTION

All the content in grade 11 Physical Sciences are built on top of your understanding of grade 10 Physical Sciences and all knowledge acquired in grade 10 and 11 Physical Sciences is essential for the understanding of grade 12 Physical Sciences.

The topics of Electromagnetism will be directly examined in your final grade 12 examination and will not be retaught in grade 12. It is therefore of utmost importance that you fully understand these topics.

Energy and change and Types of reactions is one of the most important concepts in Chemistry and requires complete understanding of atomic structure, the periodic table, and chemical bonding.
Your preparation for your final grade 12 examination started last year. Do not be caught out!

Topics	Description
Electromagnetism	Magnetic field associated with current-carrying wires; Faraday's Law
Energy and Chemical Change	Energy changes in reactions related to bond energy changes; Exothermic and endothermic reactions; Activation energy
Types of Reactions	Acid-base ; Arrhenius and Bronsted and Lowry; ampholyte

TERMINOLOGY SESSION 1

Term	Definition
Faraday's law	The magnitude of the induced emf across the ends of a conductor is directly proportional to the rate of change in the magnetic flux linkage with the conductor. $\varepsilon = \frac{-N\Delta\phi}{\Delta t}$ ε = emf (V) N= number of turns/windings in coil Δϕ= change in magnetic flux (Wb) Δt= change in time (s)
Right hand thumb rule	**For a straight, single wire, point the thumb of your right hand in the direction of the conventional current and your curled fingers will point in the direction of the magnetic field around the wire**
Right hand solenoid rule	**Curl your fingers around the solenoid in the direction of the conventional current and your thumb will point in the direction of the induced North pole.**
Magnetic flux linkage	**Is the product of the number of turns on the coil and the flux through the coil:** $\phi = BA\cos\vartheta$ ϕ= magnetic flux (Wb) B= magnetic flux density (T) A= area (m2) θ= angle between magnetic field line and normal

Session 1: ELECTROMAGNETISM

1. The diagram below represents a current-carrying conductor. Draw the magnetic field pattern around this conductor : (2)

2. A solenoid with a radius of 5 cm and 350 turns is pulled out of a magnetic field of strength 5,20 T in 0,1 second. The solenoid is placed perpendicular to the magnetic field.

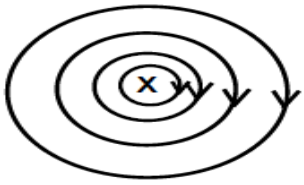
2.1 State Faraday's law in words. (2)

2.2 Calculate the magnetic flux linkage (Φ) with the solenoid. (3)

2.3 Calculate the induced emf in the solenoid. (3)
[10]

Answers:

1.



CRITERIA FOR MARKING/ *KRITERIA VIR NASIEN*	
Circular shape/ *Korrekte vorm*	✓
Field direction/ *Veldrigting*	✓

(2)

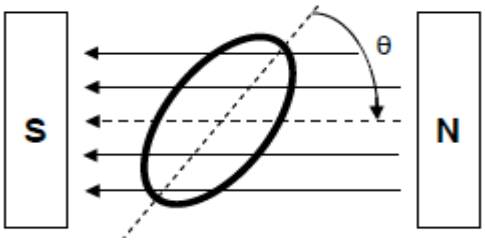
2.1 The magnitude of the induced emf across a conductor is directly proportional to the rate of change in the magnetic flux linkage with the conductor. ✓✓
Die grootte van die geïnduseerde emk oor die geleier is direk eweredig aan die tempo van verandering in die magnetiese vloed met die geleier. (2)

2.2 $\Phi = B\,A\cos\theta$
$\Phi = B\,(\pi r^2)\cos\theta$ } Any one/*Enige een* ✓
$\Phi = 3{,}5\,(\pi \times 0{,}05^2)\cos 0^\circ$ ✓
$\Phi = 0{,}03$ Wb ✓ (0,027 Wb) (3)

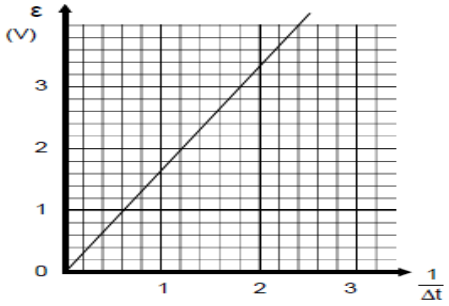
2.3 $\varepsilon = \frac{-N\Delta\Phi}{\Delta t}$ ✓
$\varepsilon = \frac{-350(0 - 0{,}03)}{0{,}1}$ ✓
$\varepsilon = 105$ V ✓ (3)

Session 1: Problem 01(Electromagnetism NOV 2017)

An induction coil of area 48,6 cm^2 and 200 windings is rotated clockwise in a constant magnetic field of magnitude 2,4 T. Refer to the diagram below.



The graph below shows how the induced emf varies with the inverse of time.



1 State *Faraday's law* in words. (2)

2. Use the information in the graph to calculate the change in magnetic flux. (5)

3. The coil rotates through an angle θ to a position where the magnetic flux becomes zero. Calculate angle θ. (4)

SESSION 1 | ELECTROMAGNETISM

SUMMARY

WHAT YOU SHOULD KNOW

Electromagnetism:
Magnetic field associated with current-carrying conductors

• Use the right hand rule to determine the magnetic field (B) associated with a:
o Straight current-carrying conductor
o Current-carrying loop (single turn)
o Solenoid
• Draw the magnetic field pattern around a:
o Straight current-carrying wire
o Current-carrying loop (single turn)
o Solenoid

Faraday's law
• State Faraday's law of electromagnetic induction: The magnitude of the induced emf across the ends of a conductor is directly proportional to the rate of change in the magnetic flux linkage with the conductor.
• Use the right-hand rule to determine the direction of the current induced in a solenoid when a pole of a bar magnet moves into and out of the solenoid.
• Solve problems using : $\Phi = BA\cos\theta$. Φ
• Predict the direction of the induced current in a coil.
• Solve problems using : $\varepsilon = \frac{-N\Delta\phi}{\Delta t}$

Question
The magnitude of the induced emf across the ends of a loop is equal to the ...

A. radius of the loop.
B. thickness of the wire.
C. temperature of the wire
D. rate of change the magnetic flux linkage with the wire.

SESSION 2 TERMINOLOGY ON ENERGY AND CHANGE

Term	Definition
Energy changes in reactions related to bond energy changes	Define heat of reaction (ΔH) as the energy absorbed or released per mole in a chemical reaction. $\Delta H = H^{products} - H^{reactants}$, where $H^{products}$ and $H^{reactants}$ are the heat (energy) of the products and reactants respectively. .
Exothermic reactions	**Define exothermic reactions as reactions that release energy** **State that ΔH < 0 for exothermic reactions, i.e. reactions in which energy is released**
Endothermic reactions	**Define endothermic reactions as reactions that absorb energy.** **State that ΔH > 0 for endothermic reactions, i.e. reactions in which energy is absorbed.**
activation energy	**minimum energy needed for a reaction to take place.**
activated complex	**the unstable transition state from reactants to products**
catalyst	**is a substance that increases the rate of the reaction but remains unchanged at the end of the reaction**

ADAPTED FROM: NOVEMBER 2017 PAPER 2 QUESTION 7

The equation for the combustion of butane gas is given below.

$butane(g) + 13O^2(g) \rightarrow 8CO^2(g) + 10H^2O(g)$

1.Define the term *activation energy.* (2)

2. Is the combustion reaction of butane *exothermic* or *endothermic*? Give a reason for the answer. (2)

3. Draw a sketch graph of potential energy versus course of reaction for the reaction above. Clearly indicate the following on the graph: (3)

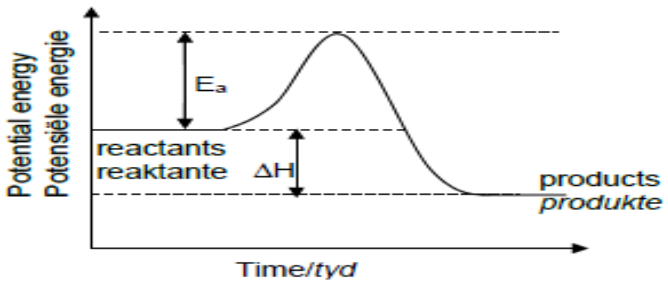
- Activation energy
- Heat of reaction (ΔH)
- Reactants and products

Answers:

1. The minimum energy needed for a reaction to take place.
Die minimum energie benodig vir die reaksie om plaas te vind.

2. An exothermic reaction releases energy **OR** ΔH < 0
'n Eksotermiese reaksie stel energie vry **OF** *ΔH < 0*

3



MARKING CRITERIA/*NASIENKRITERIA*	
Activation energy E_a correct position and labelled *Aktiveringsenergie E_a korrekte posisie en benoem*	✓
Heat of reaction ΔH correct position and labelled *Reaksiewarmte ΔH korrekte posisie en benoem*	✓
Products have lower energy than reactants *Produkte het laer energie as reaktanse*	✓

(3)

Session 2: Problem (ENERGY AND CHANGE EC NOV 2020)

Learners study ENDOTHERMIC and EXOTHERMIC reactions by conducting experiments **I** and **II** in which the reactions shown in the table below take place.

EXPERIMENT	BALANCED EQUATION
I	$2\ H_2O_2\ (\ell) \rightarrow 2\ H_2O\ (\ell) + O_2(g)$
II	$2\ H_2O\ (\ell) \rightarrow 2\ H_2\ (g) + O_2\ (g)$

The learners measured the initial and final temperatures of the reaction mixtures. They also obtained activation energies for the reactions from a data table.

The learners represented their findings in a table as shown below.

EXPERIMENT	Initial (°C)	Final (°C)	Activation energy (kJ/mol)
I	24	36	75
II	24	18	237

1 Define the term *activation energy.* (2)

2 In which experiment (**I** or **II**) is the reaction EXOTHERMIC? Explain your answer. (2)

3 Is the heat of the reaction, ΔH, POSITIVE or NEGATIVE for an EXOTHERMIC reaction? (1)

4.Write down the general name of a substance that can be added to the reaction mixture in experiment **II** to reduce the activation energy. (1)

5. Draw a potential energy versus time graph for the reaction in experiment **II**.
The following must be shown on the graph.

- Heat of the reaction (ΔH)
- Activation energy (3)

SESSION 2 | Chemical change

SUMMARY

WHAT YOU SHOULD KNOW

Energy changes in reactions related to bond energy changes

• Define heat of reaction (ΔH) as the energy absorbed or released per mole in a chemical reaction.

$\Delta H = H^{products} - H^{reactants}$, where $H^{products}$ and $H^{reactants}$ are the heat (energy) of the products and reactants respectively.

• Define exothermic reactions as reactions that release energy.
• Define endothermic reactions as reactions that absorb energy.
• Classify, with reason, reactions as exothermic or endothermic.

Exothermic and endothermic reactions

• State that $\Delta H > 0$ for endothermic reactions, i.e. reactions in which energy is absorbed.
• State that $\Delta H < 0$ for exothermic reactions, i.e. reactions in which energy is released.

Activation energy

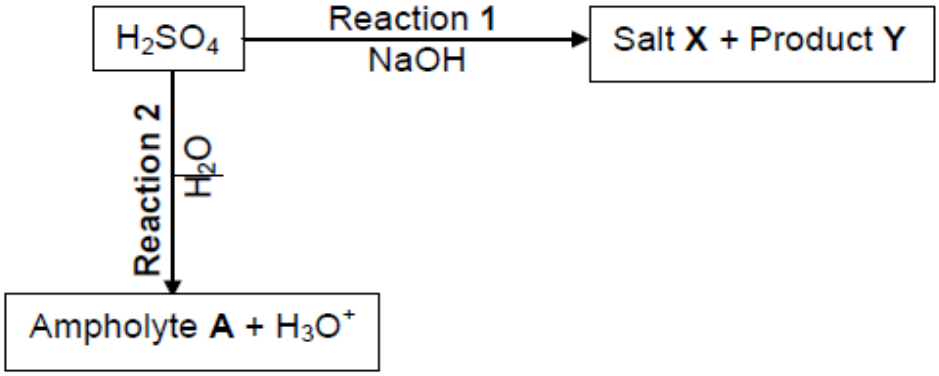
• Define activation energy as the minimum energy needed for a reaction to take place.
• Define an activated complex as the unstable transition state from reactants to products.
• Draw or interpret fully labelled sketch graphs (potential energy versus course of reaction graphs) of catalysed and uncatalysed endothermic and exothermic reactions.

TERMINOLOGY SESSION 3 TYPES OF REACTIONS

Term	Definition
Arrhenius:	An **acid** is a substance that produces hydrogen ions (H+)/ hydronium ions (H3O+) when it dissolves in water. A **base** is a substance that produces hydroxide (OH−) when dissolved in water.
Lowry-Brønsted	An **acid** is a proton (H+ ion) donor. A **base** is a proton (H+ ion) acceptor
CONJUGATE ACID-BASE PAIRS	• An acid forms a conjugate base when it donates a proton. • A base forms a conjugate acid when it accepts a proton
AMPHOLYTE/ AMPHIPROTIC SUBSTANCES	**A substance that can act as either an acid or a base.**
A strong acid **A weak acid** **A strong base** **A weak base**	• will **ionise** completely in water. • will only partially **ionise** in water • will **dissociate** completely in water. • will **dissociate** only partially in water.
CONJUGATE ACID-BASE PAIRS	• An acid forms a conjugate base when it donates a proton • A strong base will **dissociate** completely in water.

ADAPTED FROM: NOVEMBER 2017 PAPER 2 QUESTION 8

1. Two reactions of sulphuric acid are shown in the diagram below.



1.1	Define a *Lowry-Brønsted base*.	(2)
1.2	Write down a balanced equation for Reaction **1**.	(3)
1.3	Write down the NAME of the salt represented by X.	(2)
1.4	Write down the FORMULA of ampholyte A.	(2)
1.5	Write down the formulae of the TWO conjugate acid-base pairs in Reaction **2**.	(4)

ANSWERS:

1.1 A base is proton acceptor ✓✓
'n Basis is 'n protonontvanger ✓✓ (2)

1.2 $H_2SO_4(aq) + 2NaOH\ (aq)$ ✓ $\rightarrow Na_2SO_4\ (aq) + 2H_2O\ (\ell)$ ✓ balance/*balans* ✓ (3)

1.3 Sodium sulphate ✓✓/*Natriumsulfaat* ✓✓ (2)

1.4 HSO_4^- ✓✓ (2)

1.5 HSO_4^- and/*en* H_2SO_4 ✓✓
H_2O and/*en* H_3O^+ ✓✓ (4)

Session 3: Problem (Types of Reactions)

1 Consider the chemical reaction below:

$$HPO_4^{2-}(aq) + H_2O(\ell) \rightarrow PO_4^{3-}(aq) + H_3O^+(aq)$$

1.1 Define a *base* according to a Lowry-Bronsted theory. (2)

1.2 Write down ONE conjugate acid-base pair in the equation. (1)

1.3 Is the reaction mixture ACIDIC or ALKALINE at the completion of the reaction? Give a reason for your answer. (2)

1.4 Write down the formula of a substance in the reaction, other than H2O, that can act as an ampholyte in some reactions. (2)

2. Copper (II) oxide (CuO) reacts with nitric acid. Write down a balanced equation for the reaction. (3)

ACTIVITY

Types of Reactions

Adapted from Nov 2018...

Ammonia can readily dissolve in water according to the equation below:

$$NH_3(g) + H_2O(\ell) \rightarrow NH_4^+(aq) + OH^-(aq)$$

1 Explain why a hydroxide ion is regarded as a Lowry-Brønsted base. (2)

2 Identify the type of bond responsible for the formation of the ammonium ion in the above equation. (1)

3 Write a balanced equation to show how the ampholyte in the above equation will act as a base when it reacts with hydrochloric acid (HCℓ). (2)

TRY AND LEARN

ACTIVITY