



education

Department:
Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

PHYSICAL SCIENCES: CHEMISTRY (P2)

EXEMPLAR 2007

MARKS: 150

TIME: 3 hours

**This question paper consists of 17 pages, a data sheet of two pages, an answer sheet,
and graph paper.**

INSTRUCTIONS AND INFORMATION

1. Write your name and/or examination number (and centre number if applicable) in the appropriate spaces on the ANSWER BOOK, ANSWER SHEET and GRAPH PAPER.
2. Answer ALL the questions from QUESTION 1 to QUESTION 14.
Answer ONE of QUESTION 15 or QUESTION 16 or QUESTION 17.
3. Answer SECTION A on the attached ANSWER SHEET.
4. Answer SECTION B in the ANSWER BOOK.
5. Non-programmable calculators may be used.
6. Appropriate mathematical instruments may be used.
7. Number the answers correctly according to the numbering system used in this question paper.
8. A data sheet is attached for your use.
9. Wherever motivation, discussion, et cetera is required, be brief.

SECTION A

Answer this section on the attached ANSWER SHEET.

QUESTION 1: ONE-WORD ITEMS

Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1 - 1.5) on the answer sheet.

- | | | |
|-----|---|-----|
| 1.1 | The distance between two atoms in a molecule | (1) |
| 1.2 | Compounds that consist of hydrogen and carbon only | (1) |
| 1.3 | A chemical reaction during which electrons are transferred | (1) |
| 1.4 | A measure of how much solute is dissolved in a solution | (1) |
| 1.5 | The earth's crust together with the upper layer of the mantle | (1) |
- [5]**

QUESTION 2: MATCHING ITEMS

Choose an item from COLUMN B that matches a description in COLUMN A. Write only the letter (A - I) next to the question number (2.1 - 2.5) on the answer sheet.

COLUMN A		COLUMN B	
2.1	The chemical bond in this molecule is a triple bond	A	N_2O
2.2	A naturally occurring greenhouse gas	B	fractionating
2.3	The conjugate base of NH_4^+	C	C_2H_2
2.4	The process whereby long chain hydrocarbons are broken down into smaller molecules	D	polymerisation
2.5	The tendency of an atom in a molecule to attract bonding electrons	E	valence electrons
		F	NH_3
		G	electronegativity
		H	cracking
		I	NH_2^-

[5]**QUESTION 3: TRUE OR FALSE**

Indicate whether the following statements are TRUE or FALSE. Write only 'true' or 'false' next to the question number (3.1 - 3.5) on the answer sheet. If the statement is FALSE, write down the correct statement.

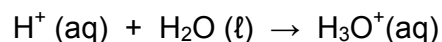
- 3.1 The C-H bond is stronger than the C-C bond because an H-atom is bigger than a C-atom. (2)
- 3.2 Carbon dioxide gas behaves more like an ideal gas than does hydrogen gas. (2)
- 3.3 Energy is released in all chemical reactions. (2)
- 3.4 According to the kinetic molecular theory of gases, all gas molecules have the same kinetic energy at the same temperature. (2)
- 3.5 Polythene is a dimer of ethene. (2)

[10]

QUESTION 4: MULTIPLE-CHOICE QUESTIONS

Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Choose the correct answer and mark the appropriate block (A – D) next to the question number (4.1 – 4.5) on the answer sheet with a cross (X).

- 4.1 The following chemical equation represents the formation of the hydronium ion:



In this reaction water acts as a Lewis base because it ...

- A accepts protons.
- B donates protons.
- C accepts electrons.
- D donates electrons.

(3)

- 4.2 The minimum energy that colliding molecules must have in order for a reaction to occur, is called ... energy.

- A bonding
- B lattice
- C activation
- D ionisation

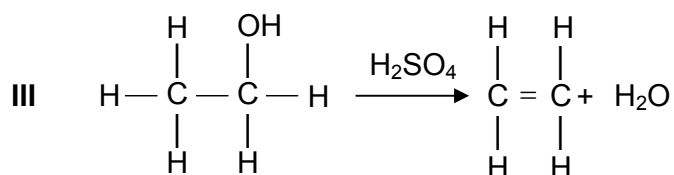
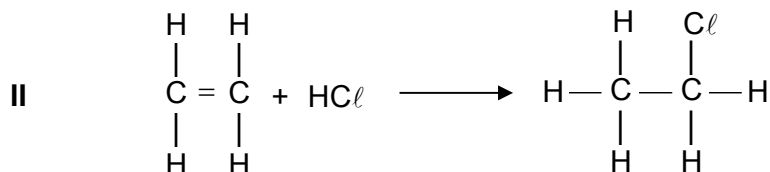
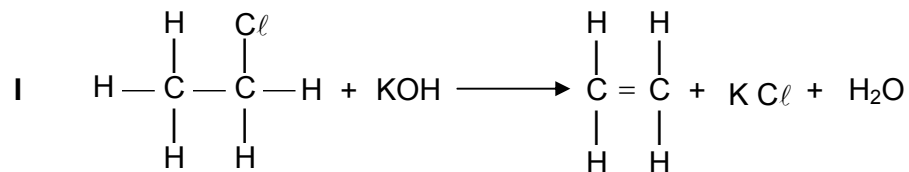
(3)

- 4.3 Which ONE of following best describes the bond formed between an H^+ ion and the NH_3 molecule?

- A Covalent bond
- B Dative covalent (coordinate covalent) bond
- C Ionic bond
- D Hydrogen bond

(3)

4.4 Three different types of chemical reactions, I, II and III, are shown below:



Which ONE of the following combinations is the CORRECT description of the three reactions?

	I	II	III
A	dehydration	dehydrohalogenation	substitution
B	dehydrohalogenation	substitution	dehydration
C	dehydrohalogenation	addition	dehydration
D	dehydration	dehydrohalogenation	addition

(3)

4.5 The ideal gas equation is given by $pV = nRT$. Which ONE of the following conditions is TRUE according to Avogadro's hypothesis?

A	$p \propto \frac{1}{V}$	(T = constant)
B	$V \propto T$	(p = constant)
C	$V \propto n$	(p, T = constant)
D	$p \propto T$	(n = constant)

(3)
[15]**TOTAL SECTION A: 35**

Please turn over

SECTION B**INSTRUCTIONS**

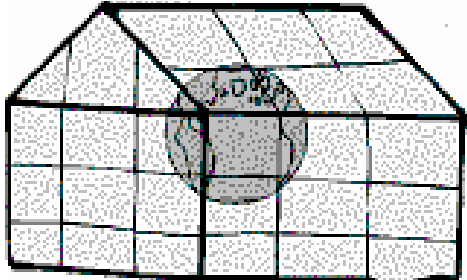
1. Answer this section in the ANSWER BOOK.
2. In ALL calculations, formulae and substitutions must be shown.
3. Round off your answers to TWO decimal places.
4. **ANSWER ONLY ONE OF QUESTION 15 OR QUESTION 16 OR QUESTION 17.**

QUESTION 5

Read the following passage and answer the questions that follow:

Planet Earth in danger!

It is now accepted that greenhouse gases are to blame for planet earth getting warmer. The increase in the number of sudden floods in Asia and droughts in Africa; the rising sea level and increasing average temperatures are global concerns. Without natural greenhouse gases, like carbon dioxide and water vapour, life on earth is not possible. However, the increase in levels of carbon dioxide in the atmosphere since the Industrial Revolution is of great concern.



Greater disasters are to come, which will create millions of climate refugees. It is our duty to take action for the sake of future generations who will pay dearly for the wait-and-see attitude of the current generation. Urgent action to reduce waste is needed. Global warming is a global challenge and calls for a global response now, not later.

[Adapted from a speech by the French President, Jacques Chirac.]

- 5.1 How do greenhouse gases, such as carbon dioxide, heat up the earth's surface? (2)
- 5.2 Draw a Lewis structure for the carbon dioxide molecule. (2)
- 5.3 The chemical bonds within the carbon dioxide molecule are polar. Support this statement by performing a calculation using the table of electronegativities. (2)

- 5.4 Classify the carbon dioxide molecule as polar or non-polar. Give a reason for your answer. (2)

Nitrogen is the most abundant gas in the atmosphere, but is not a greenhouse gas.

- 5.5 In terms of charge distribution and dipole moments, explain why carbon dioxide is a greenhouse gas, but nitrogen is not a greenhouse gas. (2)

- 5.6 Suggest ONE way in which YOU can help to reduce the emissions of greenhouse gases. (2)
- [12]**

QUESTION 6

In an experiment to determine the relationship between pressure and temperature of a fixed mass of gas, a group of learners obtained the following results:

Pressure (kPa)	101	120	130,5	138
Temperature (°C)	0	50	80	100
Total gas volume (cm ³)	250	250	250	250

- 6.1 Draw a straight-line graph of pressure (on the dependent, y-axis) versus temperature (on the independent, x-axis) on the attached graph paper. Choose an appropriate scale for the axes provided. Plot the points. Supply a suitable heading for your graph. (5)

A straight-line graph passing through the origin is essential to obtain a mathematical relationship between pressure and temperature.

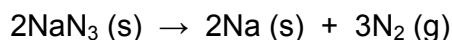
- 6.2 Extrapolate (extend) your graph and determine the temperature (in °C) at which the graph will pass through the temperature axis. (2)
- 6.3 Write down, in words, the relationship between pressure and Kelvin temperature. (2)
- 6.4 From your graph, determine the pressure (in kPa) at 173 K. Indicate on your graph how you obtained this value. (2)
- 6.5 How would the gradient of the graph be affected (if at all) if a larger mass of the gas is used? Write down **ONLY increases, decreases or remains the same.** (2)

[13]

QUESTION 7

Most modern cars are equipped with airbags for both the driver and the passenger. An airbag will completely inflate in 0,05 s. This is important because a typical car collision lasts about 0,125 s.

The following reaction of sodium azide (a compound found in airbags) is activated by an electrical signal:



7.1 Calculate the mass of $\text{N}_2(\text{g})$ needed to inflate a sample airbag to a volume of 65 dm^3 at $25 \text{ }^\circ\text{C}$ and $99,3 \text{ kPa}$. Assume the gas temperature remains constant during the reaction. (7)

7.2 In reality the above reaction is exothermic. Describe, in terms of the kinetic molecular theory, how the pressure in the sample airbag will change, if at all, as the gas temperature returns to $25 \text{ }^\circ\text{C}$. (3)
[10]

QUESTION 8

Vinegar, which is used in our homes, is a dilute form of acetic acid. A sample of acetic acid has the following percentage composition:

39,9% carbon
6,7% hydrogen
53,4% oxygen

8.1 Determine the empirical formula of acetic acid. (5)

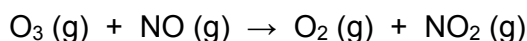
8.2 Determine the molecular formula of acetic acid if the molar mass of acetic acid is $60 \text{ g}\cdot\text{mol}^{-1}$. (2)
[7]

QUESTION 9

Ozone (O₃) reacts with nitrogen monoxide gas (NO) to produce NO₂ gas. The NO gas forms largely as a result of emissions from the exhausts of motor vehicles and from certain jet planes.

The NO₂ gas also causes the brown smog (smoke and fog), which is seen over most urban areas. This gas is also harmful to humans, as it causes breathing (respiratory) problems.

The following equation indicates the reaction between ozone and nitrogen monoxide:



In one such reaction 0,74 g of O₃ reacts with 0,67 g NO.

- 9.1 Calculate the number of moles of O₃ and of NO present at the start of the reaction. (5)
- 9.2 Identify the limiting reagent in the reaction and justify your answer. (2)
- 9.3 Calculate the mass of NO₂ produced from the reaction. (4)
- [11]**

QUESTION 10

The stomach secretes gastric juice, which contains hydrochloric acid. The gastric juice helps with digestion. Sometimes there is an overproduction of acid, leading to heartburn or indigestion. Antacids, such as milk of magnesia, can be taken to neutralise the excess acid. Milk of magnesia is only slightly soluble in water and has the chemical formula Mg(OH)₂.

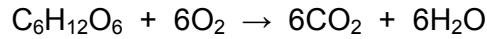
- 10.1 Write a balanced chemical equation to show how the antacid reacts with the acid. (3)
- 10.2 The directions on the bottle recommend that children under the age of 12 years take one teaspoon of milk of magnesia, whereas adults can take two teaspoons of the antacid. Briefly explain why the dosages are different. (2)
- 10.3 Why is it not advisable to take an overdose of the antacid in the stomach? Refer to the hydrochloric acid concentration in the stomach in your answer. (2)

In an experiment, 25,0 cm³ of a standard solution of sodium carbonate of concentration 0,1 mol·dm⁻³ was used to neutralise 35,0 cm³ of a solution of hydrochloric acid.

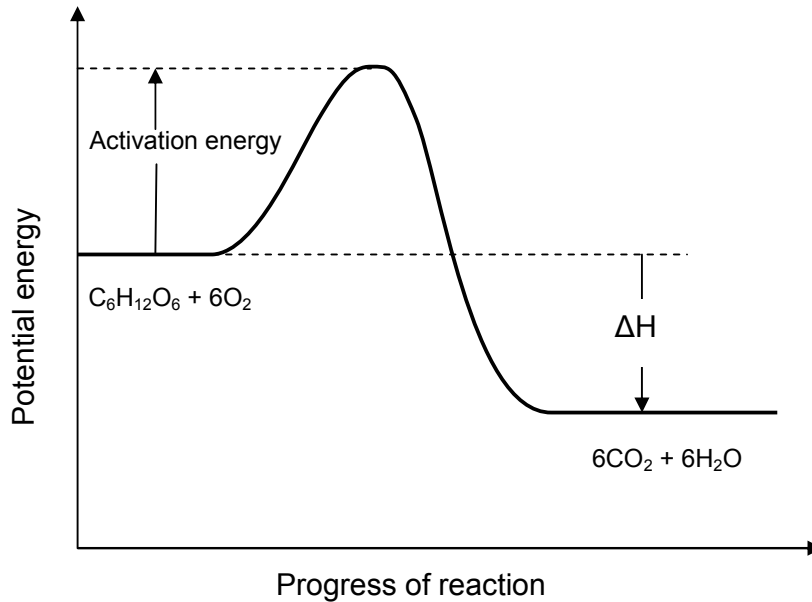
- 10.4 Write a balanced chemical equation for the reaction. (3)
- 10.5 Calculate the concentration of the acid. (5)
- [15]**

QUESTION 11

During the process of cellular respiration, glucose is broken down to form carbon dioxide and water according to the following equation:



The reaction is catalysed by enzymes. The change in potential energy during this reaction in the human body is illustrated in the graph below:



Use the graph to answer the following questions:

- 11.1 Is the breakdown of glucose an endothermic or an exothermic reaction? Give a reason for your answer. (2)
- 11.2 Explain how the enzymes influence the rate of the reaction. (2)
- 11.3 Write a convincing note to your classmates explaining why regular exercise is necessary. (3)
- [7]**

QUESTION 12

A group of learners was asked to investigate the reactivity of alkanes and alkenes. They chose cyclohexane and cyclohexene as examples. Both compounds are liquids at normal temperature and pressure.

They then carried out the following experiments:

Experiment A

The learners poured a few drops of cyclohexane and cyclohexene onto two separate watch glasses and lit the liquids in a fume cupboard. Their observations are indicated in the table below:

Compound	Colour of flame	Sootiness
Cyclohexane	Orange and blue flame	No soot observed
Cyclohexene	Orange and blue flame	Slightly sooty

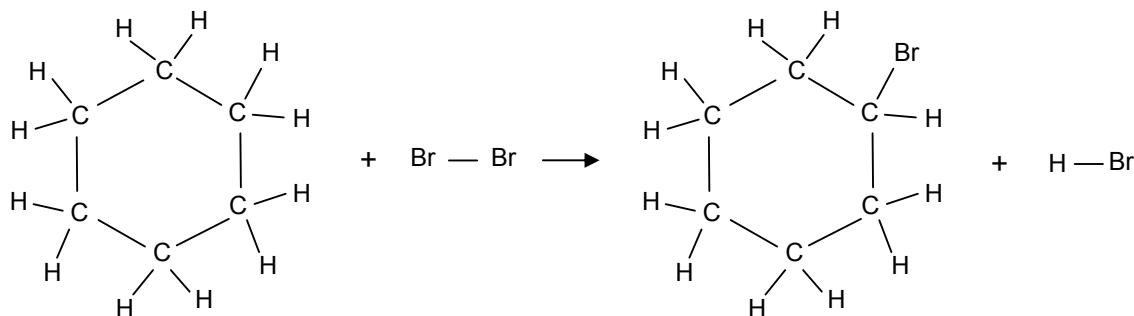
Experiment B

The learners performed the reaction of cyclohexane and cyclohexene firstly in a **darkened room**. They poured approximately 2 cm³ of cyclohexane and cyclohexene into two separate test tubes and then added a few drops of bromine to the contents of each test tube. They then repeated the experiment in **sunlight**.

Their observations are indicated in the table below:

Compound	Action of liquid bromine in the dark	Action of liquid bromine in sunlight
Cyclohexane	No visible reaction	Liquids mix and decolourise after a long time A gas evolves
Cyclohexene	Bromine decolourises slowly	Liquids mix and decolourise rapidly No gas evolves

The equation for one of the reactions is represented (structurally) below:



12.1 Write down TWO safety precautions that the learners took during the experiment.

(2)

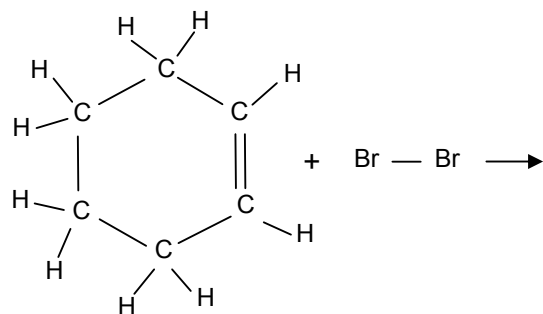
12.2 Write down a possible hypothesis for the investigation. (2)

12.3 What conclusion should the learners reach about the reactivity of the compounds as a result of the following experiments?

12.3.1 Experiment A (2)

12.3.2 Experiment B (2)

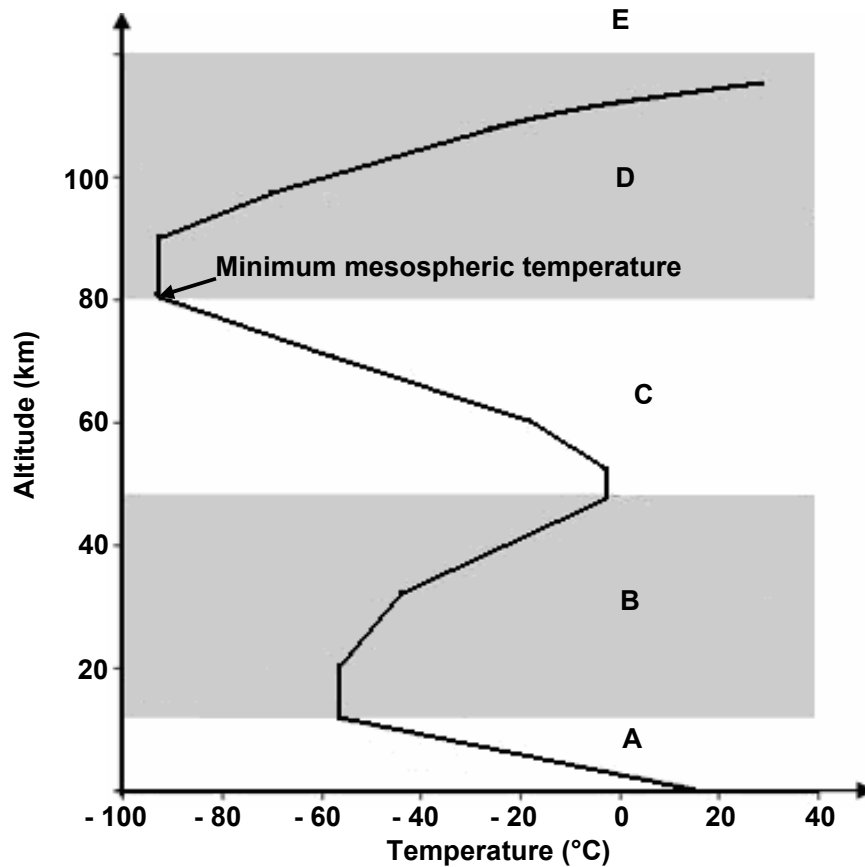
12.4 Write down the structural formula for the product of the reaction represented by the incomplete equation below:



(2)
[10]

QUESTION 13

The atmosphere is a relatively thin layer of gases which support life and provide protection to living organisms. The force of gravity holds the atmosphere against the earth. The diagram below shows the temperature associated with the various layers that make up the atmosphere and the altitude (height) from the earth's surface.



- 13.1 Write down the names of the layers A, B and D of the atmosphere. (3)
- 13.2 In which one of the layers of the atmosphere is the ozone layer found? (1)
- 13.3 Write down an explanation for the decrease in temperature as altitude increases in layer A. (2)
- 13.4 In layer B there is a steady increase in temperature as the altitude increases. Write down an explanation for this trend. (3)

[9]

QUESTION 14

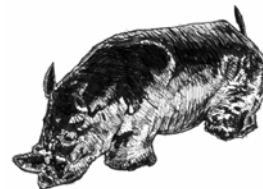
The following advertisement appeared in a local newspaper:



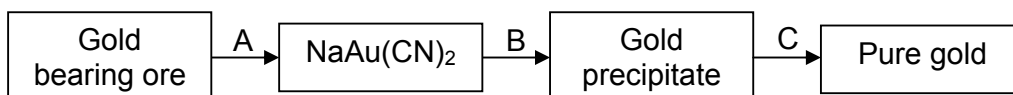
- 14.1 'Coal is as old as the hills and just as natural.' Is this statement TRUE? Motivate your answer by referring to the formation of coal. (2)
- 14.2 Coal is a non-renewable energy source. Quote a statement from the advertisement that gives an indication that coal is non-renewable. Give a reason for your choice. (2)
- 14.3 Is coal a healthy source of energy as indicated in the advertisement? Motivate your answer by referring to all influences that coal and coal mining have on the environment and humans. (4)
- 14.4 Why is coal used as primary energy source in South Africa? (2)
- [10]**

ANSWER ONLY ONE OF QUESTION 15 OR QUESTION 16 OR QUESTION 17.**QUESTION 15**

Mapungubwe in the Limpopo Province is evidence of gold mining in South Africa as early as 1200. Today, South Africa is a world leader in the technology of gold mining.



The following flow diagram illustrates some of the most important steps in the recovery of gold from the ore:

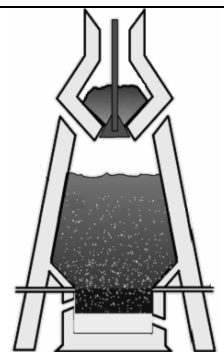
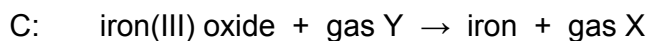
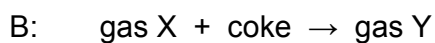
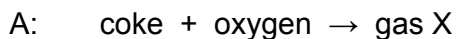


- 15.1 Name the process indicated by A. (2)
- 15.2 During process A, gold is extracted from the ore. Is gold oxidised or reduced in this process? (1)
- 15.3 Use oxidation numbers to explain your answer to QUESTION 15.2. (2)
- 15.4 Name the chemical substance used in process B. (2)
- 15.5 During smelting, illustrated by C in the diagram, gold is sent into a calcining furnace. Briefly explain the importance of this process taking place in this furnace. (2)
- 15.6 Recovery of gold can have a negative influence on water in our country, if not managed properly. State at least ONE negative influence that the recovery of gold can have on our water resources, and how it will impact on the environment and humans. (2)

[11]

QUESTION 16

Iron is usually extracted from haematite (iron(III) oxide). Iron ore is mixed with limestone and coke in a blast furnace to produce the metal. The following incomplete word equations describe the extraction process:

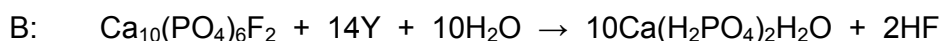
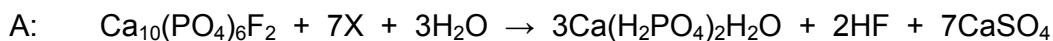


- 16.1 Name the gases X and Y. (2)
- 16.2 Write a balanced chemical equation for reaction C. (3)
- 16.3 What is the function of gas Y in reaction C? (2)
- 16.4 Why is limestone added to the reaction mixture? (2)
- 16.5 Briefly describe the impact that the mining of iron has on the economy and the environment in our country. (2)

[11]

QUESTION 17

Rock phosphate [$\text{Ca}_{10}(\text{PO}_4)_6\text{F}_2$], mined from open pit mines at Phalaborwa, is an important raw material in the production of fertilisers. The following two reactions are used to transform rock phosphate into water soluble phosphates:



- 17.1 Identify the acids represented by X and Y. (4)
- 17.2 Despite similar molecular formulae, the products $\text{Ca}(\text{H}_2\text{PO}_4)_2$ formed in the two reactions have different common names. Write down the names for each of these products in reactions A and B. (2)
- 17.3 Refer to the products in reactions A and B and write down TWO advantages of reaction B over reaction A. (2)
- 17.4 Why is rock phosphate unsuitable as fertiliser? (1)
- 17.5 State ONE advantage and ONE disadvantage of phosphate mining. (2)

[11]**TOTAL SECTION B: 115****GRAND TOTAL: 150**

**NATIONAL SENIOR CERTIFICATE EXAMINATION
NASIONALE SENIOR SERTIFIKAAT-EKSAMEN**

**DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 2 (CHEMISTRY)**

**GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11
VRAESTEL 2 (CHEMIE)**

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESE KONSTANTES

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Avogadro's constant <i>Avogadro-konstante</i>	N_A	$6,02 \times 10^{23} \text{ mol}^{-1}$
Molar gas constant <i>Molêre gaskonstante</i>	R	$8,31 \text{ J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$
Standard pressure <i>Standaarddruk</i>	p^θ	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Molêre gasvolume by STD</i>	V_m	$22,4 \text{ dm}^3\cdot\text{mol}^{-1}$
Standard temperature <i>Standaardtemperatuur</i>	T^θ	273 K

TABLE 2: FORMULAE/TABEL 2: FORMULES

$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$	$pV = nRT$
$n = \frac{m}{M}$	$c = \frac{n}{V}$
$c = \frac{m}{MV}$	$\frac{n_a}{n_b} = \frac{c_a V_a}{c_b V_b}$

NSC

NAME/EXAMINATION NUMBER:

**PHYSICAL SCIENCES GRADE 11 ANSWER SHEET
FISIESE WETENSAPPE GRAAD 11 ANTWOORDBLAD**

QUESTION 1/VRAAG 1

- 1.1 _____ (1)
 1.2 _____ (1)
 1.3 _____ (1)
 1.4 _____ (1)
 1.5 _____ (1)
[5]

QUESTION 2/VRAAG 2

- 2.1 _____ (1)
 2.2 _____ (1)
 2.3 _____ (1)
 2.4 _____ (1)
 2.5 _____ (1)
[5]

QUESTION 3/VRAAG 3

- 3.1 _____
 _____ (2)
 3.2 _____
 _____ (2)
 3.3 _____
 _____ (2)
 3.4 _____
 _____ (2)
 3.5 _____
 _____ (2)
[10]

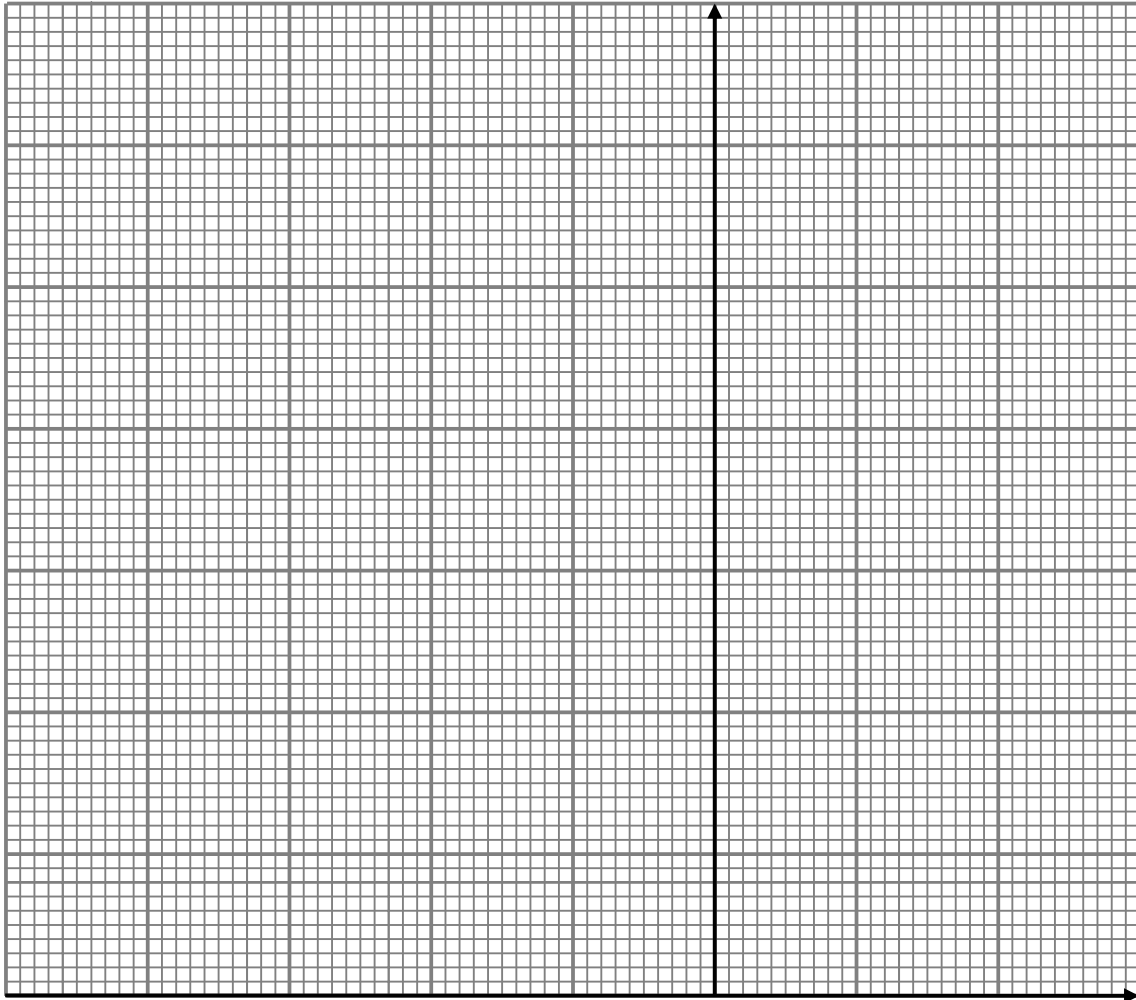
QUESTION 4/VRAAG 4

4.1	A	B	C	D
4.2	A	B	C	D
4.3	A	B	C	D
4.4	A	B	C	D
4.5	A	B	C	D

(5 x 3) [15]**TOTAL SECTION A/TOTAAL AFDELING A: 35**

NAME/EXAMINATION NUMBER:

QUESTION 6.1



(5)

Question No.	LO 1				LO 2			LO 3			TOTAL	Taxonomy				TOTAL	Knowledge Areas			TOTAL MARKS	Question Totals		
	AS 1	AS 2	AS 3	AS 4	AS 1	AS 2	AS 3	AS 1	AS 2	AS 3		Knowledge, Recall, Low Demand	COMPREHENSION, Basic Questions	APPLICATION, ANALYSIS, Basic Routine Ex., Problem Solving	SYNTHESIS, EVALUATION, Higher Abilities, Hard new problems, Challenge Level		Matter and Materials	Chemical Change	Chemical Systems				
	Marks				Marks			Marks							Marks								
1.1					1						1	1						1	1	1	1		Yes
1.2					1						1	1						1		1	1		Yes
1.3					1						1	1						1	1	1	1		Yes
1.4					1						1	1						1	1	1	1		Yes
1.5					1						1	1						1		1	1	5	Yes
2.1							1				1	1						1		1	1		Yes
2.2					1						1	1						1		1	1		Yes
2.3							1				1		1					1		1	1		Yes
2.4					1						1	1						1	1	1	1		Yes
2.5					1						1	1						1	1	1	1	5	Yes
3.1						2					2		2					2	2		2		Yes
3.2						2					2		2					2	2		2		Yes
3.3					2						2	2						2		2	2		Yes
3.4					2						2	2						2	2		2		Yes
3.5					2						2	2						2		2	2	10	Yes
4.1							3				3		3					3		3	3		Yes
4.2					3						3	3						3		3	3		Yes
4.3							3				3		3					3	3		3		Yes
4.4							3				3			3				3		3	3		Yes
4.5					3						3			3				3	3		3	15	Yes

Question No.	LO 1				LO 2			LO 3			TOTAL	Taxonomy				Knowledge Areas				TOTAL MARKS	Question Totals			
	AS 1	AS 2	AS 3	AS 4	AS 1	AS 2	AS 3	AS 1	AS 2	AS 3		Knowledge, Recall, Low Demand	COMPREHENSION, Basic Questions	APPLICATION, ANALYSIS, Basic Routine Ex., Problem Solving	SYNTHESIS, EVALUATION, Higher Abilities, Hard new problems, Challenge Level	TOTAL	Matter and Materials	Chemical Change	Chemical Systems					
	Marks				Marks			Marks								Marks								
5.1					2						2		2					2		2				Yes
5.2							2				2		2					2		2				Yes
5.3							2				2		2					2		2				Yes
5.4							2				2		2					2		2				Yes
5.5					2						2		2					2		2				Yes
5.6										2	2		2					2		2		2	12	Yes
6.1	5										5		5					5	5			5		Yes
6.2	2										2		2					2	2			2		Yes
6.3	2										2	2						2	2			2		Yes
6.4	2										2		2					2	2			2		Yes
6.5	2										2		2					2	2			2	13	Yes
7.1			7								7		7					7	7			7		Yes
7.2					3						3			3				3	3			3	10	Yes
8.1			5								5		5					5				5		Yes
8.2						2					2		2					2	2			2	7	Yes

Question No.	LO 1				LO 2			LO 3			TOTAL	Taxonomy				TOTAL	Knowledge Areas			TOTAL MARKS	Question Totals
	AS 1	AS 2	AS 3	AS 4	AS 1	AS 2	AS 3	AS 1	AS 2	AS 3		Knowledge, Recall, Low Demand	COMPREHENSION, Basic Questions	APPLICATION, ANALYSIS, Basic Routine Ex., Problem Solving	SYNTHESIS, EVALUATION, Higher Abilities, Hard new problems, Challenge Level		Matter and Materials	Chemical Change	Chemical Systems		
	Marks				Marks			Marks								Marks					
9.1							5				5		5		5			5	5		Yes
9.2							2				2		2		2			2	2		Yes
9.3			4								4		4		4			4	4	11	Yes
10.1							3				3	3			3		3	3	3		Yes
10.2									2		2			2	2		2	2	2		Yes
10.3									2		2			2	2		2	2	2		Yes
10.4							3				3	3			3		3	3	3		Yes
10.5			5								5		5		5		5	5	5	15	Yes
11.1		2									2	2			2		2	2	2		Yes
11.2		2									2	2			2		2	2	2		Yes
11.3									3		3			3	3		3	3	3	7	Yes
12.1	2										2	2			2		2	2	2		Yes
12.2	2										2			2	2		2	2	2		Yes
12.3.1		2									2			2	2		2	2	2		Yes
12.3.2		2									2			2	2		2	2	2		Yes
12.4							2				2	2			2		2	2	2	10	Yes

