

Province of the  
**EASTERN CAPE**  
EDUCATION

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 11**

**PHYSICAL SCIENCES – SECOND PAPER  
NOVEMBER 2009**

**MARKS: 150**

**TIME: 3 hours**



This question paper consists of 12 pages, a 4-page data sheet, graph paper and an answer sheet.

**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 attached ANSWER SHEET.

- 1.1 A gas which is closest to an ideal gas. (1)
- 1.2 The formula that represents the lowest whole number ratio of the atoms of the elements in a compound. (1)
- 1.3 A reaction where energy is liberated. (1)
- 1.4 A chemical bond formed by non-metals. (1)
- 1.5 A homologous series with a general formula of  $C_nH_{2n+2}$ . (1)
- [5]**

**QUESTION 2: FALSE ITEMS**

The following are FALSE conceptual statements. Write next to the question number (2.1 – 2.5) on the attached ANSWER SHEET the CORRECT statement.

- 2.1 A gas which obeys Boyle's law is a real gas. (2)
- 2.2 All s-orbitals are symmetrically oval. (2)
- 2.3 Enthalpy is the minimum amount of energy required for a reaction to occur. (2)
- 2.4 Absolute zero temperature is a temperature of 0 kelvin when the volume is also zero. (2)
- 2.5 Alkenes have only C—C single bonds. (2)
- [10]**

**QUESTION 3: MULTIPLE-CHOICE QUESTIONS**

Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Choose the best answer and make a cross (X) in the correct block (A – D) next to the question number (3.1 – 3.5) on the attached ANSWER SHEET.

- 3.1 The enthalpy change of a combustion reaction is always ...
- A negative.
  - B positive.
  - C zero.
  - D uncalculatable. (2)
- 3.2 The number of atoms in 2 mol of H<sub>2</sub>O is ...
- A 1,8 x 10<sup>2</sup>.
  - B 22,4.
  - C 36.
  - D 3,6 x 10<sup>24</sup>. (2)
- 3.3 In the reaction  $2\text{HCl} + \text{Zn} \rightarrow \text{ZnCl}_2 + \text{H}_2$  the reducing agent is ...
- A H<sub>2</sub>.
  - B ZnCl<sub>2</sub>.
  - C Zn.
  - D HCl. (2)
- 3.4 The iron which is extracted from a blast furnace still contains impurities. This iron is usually known as ...
- A soft iron.
  - B steel.
  - C pig iron.
  - D slag. (2)
- 3.5 Sunflower oil undergoes hydrogenation during the manufacturing process of margarine. During this process the ...
- A number of double bonds decreases.
  - B carbon chains increase in length.
  - C number of single bonds decreases.
  - D compound becomes less saturated. (2)

**[10]****TOTAL SECTION A: 25**

**SECTION B**

The formulae and substitutions must be shown in ALL calculations.  
Round off your answers to TWO decimal places.  
Start each question on a new page.

**QUESTION 4**

Both CO<sub>2</sub> and H<sub>2</sub>O molecules consist of three atoms.

- 4.1 The difference between the molecules is tabulated below. Complete the table by writing down the question number (4.1.1 – 4.1.5) and next to it the correct answer.

Factors	CO <sub>2</sub>	H <sub>2</sub> O
Lewis structure	[4.1.1]	H :Ö: •• H
Molecular shape	Linear	[4.1.2]
Polarity of bonds	[4.1.3]	polar
Polarity of molecules	Non-polar	[4.1.4]
Phase at room temperature	[4.1.5]	liquid

(5)

- 4.2 Solid NaCl is formed from solid Na and gaseous Cl<sub>2</sub> molecules. Name the type of energy involved in each of the steps given below:

4.2.1 Solid sodium is converted to sodium vapour. (2)

4.2.2 Diatomic chlorine molecules are converted to separate gaseous Cl-atoms. (2)

4.2.3 An electron is removed from each sodium atom to form Na<sup>+</sup> ions. (2)

**[11]**

## QUESTION 5

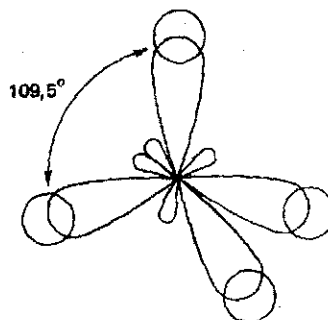
- 5.1 Which of the molecules shown in the table have the shortest bond length? (2)

Single bond	Double bond	Triple bond
H <sub>2</sub>	O <sub>2</sub>	N <sub>2</sub>

- 5.2 The difference in electronegativity between two atoms in a bond is 0 to 0,9. Name the type of bond formed between these atoms. (2)

- 5.3 Name the molecule represented by the diagram below:

Shape



(2)

- 5.4  $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{NO}(\text{g})$ .

The bond energies of  $\text{O}=\text{O}$  is  $336 \text{ kJ}\cdot\text{mol}^{-1}$ ; and  $\text{N}\equiv\text{N}$  is  $519 \text{ kJ}\cdot\text{mol}^{-1}$ .

Using the bond energies given, calculate the total energy needed to break the bonds in the above reaction.

(5)  
[11]

**QUESTION 6**

As a science learner Sono always wanted to do an investigation to study the change in volume with pressure for a sample of air.

He decided to conduct an investigation by taking measurements of volume and pressure of an enclosed amount of air.

- 6.1 Write an investigative question for Sono's experiment. (2)
- 6.2 Sono hypothesises this investigation before doing it. There are many possibilities. Give only ONE HYPOTHESIS. (2)
- 6.3 During this investigation ONE factor, that can change, is deliberately kept constant. Name that factor. (2)
- 6.4 Name ONE piece of equipment you need to conduct this investigation. (2)

Sono made 7 such measurements of pressure and the corresponding volume. He also made certain calculations and it is recorded in the table below:

Pressure (p) of air in kPa	Volume of air V in cm <sup>3</sup>	$\frac{1}{V}$ (cm <sup>-3</sup> )	pV in J
150	20	0,050=5,0x10 <sup>-2</sup>	3000 x10 <sup>-3</sup>
157,9	19	0,053=5,3x10 <sup>-2</sup>	3000 x10 <sup>-3</sup>
166,67	18	0,053=5,3x10 <sup>-2</sup>	3000 x10 <sup>-3</sup>
176,48	17	0,053=5,3x10 <sup>-2</sup>	3000 x10 <sup>-3</sup>
142,9	21	0,048=4,8x10 <sup>-2</sup>	3000 x10 <sup>-3</sup>
136,38	22	0,045=4,5x10 <sup>-2</sup>	3000 x10 <sup>-3</sup>
130,44	23	0,043=4,3x10 <sup>-2</sup>	3000 x10 <sup>-3</sup>

- 6.5 Draw a graph of p vs  $\frac{1}{V}$  taking p on the x-axis. Use the attached graph paper. (3)
- 6.6 What can you conclude about the values of pV in the last column in the table above? (1)
- 6.7 Establish a mathematical relationship between p and  $\frac{1}{V}$  from your graph. (2)
- 6.8 Name the law which describes the relationship in QUESTION 6.7. (2)
- 6.9 State the law in words which you named in QUESTION 6.8. (3)

**[19]**

**QUESTION 7**

7.1 The Haber process is used in the industrial preparation of ammonia ( $\text{NH}_3$ ). During this process, hydrogen reacts with nitrogen. In industry it is important that the correct amounts of reactants are added to each other. Chemists also need to know the total amount of product that will be produced.

7.1.1 Write down the balanced equation for the industrial preparation of ammonia. (3)

7.1.2 Write down TWO positive and TWO negative impacts of the Haber process on human development and the environment. (4)

7.2 Vinegar ( $\text{CH}_3\text{COOH}$ ) is used in the laboratory to demonstrate acid-base reactions.

7.2.1 Is vinegar a base, an acid or indicator? Give ONE characteristic to support your answer. (3)

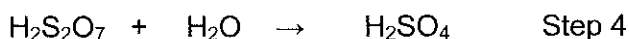
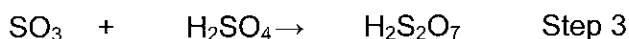
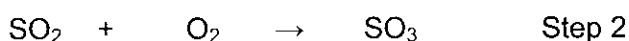
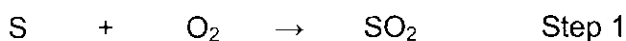
7.2.2 What is the scientific name for vinegar? (2)

7.2.3 Calculate the percentage composition of vinegar. (5)

7.2.4 When vinegar reacts with bicarbonate of soda, a salt and TWO other substances form. Name these substances. (2)

**[19]****QUESTION 8**

During the industrial preparation of sulphuric acid, a number of processes are followed. The following unbalanced reaction equations represent the processes step by step and most of them are redox reactions. The sulphuric acid that is produced is usually very thick and concentrated and scientists dilute it before use.



8.1 What is the oxidation number of sulphur in  $\text{H}_2\text{SO}_4$ ? (1)

8.2 Identify the oxidizing agent in step 1. (1)

8.3 Balance the equation in step 2. (2)

8.4 Explain how you would safely dilute sulphuric acid. (2)

**[6]**

**QUESTION 9**

Hexane is a component of petrol/fuel.

9.1 Name the homologous series to which hexane belongs. (2)

9.2 Give another use of the compounds in QUESTION 9.1. (2)

*Hexane burns in excess of oxygen.*

9.3 Give the name of the reaction that occurs. (2)

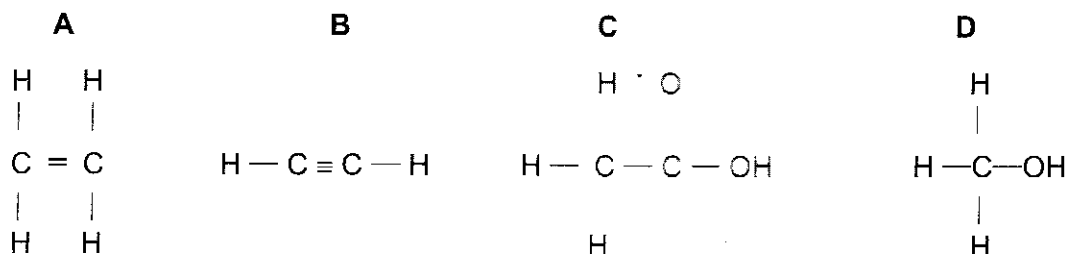
9.4 Write down your observation. (2)

9.5 Write down the balanced chemical equation for the reaction that occurs. (3)

**[11]**

**QUESTION 10**

Consider the following compounds:



10.1 Give the general formula for the homologous series to which A belongs. (2)

10.2 *Bromine reacts with compound A:*

10.2.1 What is this type of reaction called? (2)

10.2.2 Using structural formulae write an equation for the reaction in QUESTION 10.2.1. (3)

10.3 Give ONE use of compound B. (2)

10.4 An ester is formed when compound C and D react in the presence of sulphuric acid.

10.4.1 Give the structural formula of the ester. (2)

10.4.2 Name the ester. (2)

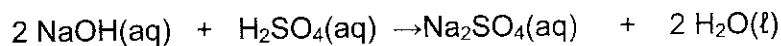
**[13]**



**QUESTION 11**

11.1 Define an acid according to the Lowry-Brønsted theory. (2)

11.2 A learner investigates a neutralization reaction using the following balanced equation:



Six grams (6,0 g) of sodium hydroxide is dissolved in 250 cm<sup>3</sup> of distilled water. 15 cm<sup>3</sup> of this solution neutralises 20 cm<sup>3</sup> of a sulphuric acid solution.

11.2.1 Calculate the number of moles of sodium hydroxide used to make the solution of sodium hydroxide. (2)

11.2.2 Calculate the concentration of the sodium hydroxide. (2)

11.2.3 Calculate the concentration of the sulphuric acid. (3)

11.3 A boy in Heath Park, Port Elizabeth, is cleaning their swimming pool and accidentally adds too much concentrated hydrochloric acid to the pool. The pH of the water decreases to 4. Explain, using a chemical equation, why the pH of the water decreased.

(4)  
**[13]**

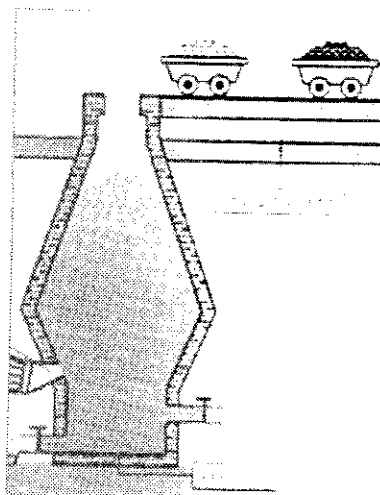
**QUESTION 12**

Most metals come from minerals. A mineral contains a range of chemical substances. If a mineral contains enough of one metal to allow economic extraction it is called an ore. There are three steps in recovering the metal from its ore.

12.1 Mention any TWO steps.

(2)

The diagram below is of a blast furnace used for the production of iron from its ore. It is usually very tall. Raw materials are added at the top and molten iron is tapped off at the bottom.



[Source: Microsoft Encarta]

In the blast furnace carbon burns in air to form carbon dioxide and the furnace becomes very hot, nearly 2000 °C. The hot carbon dioxide rises and reacts with more coke to form carbon monoxide (CO) which rises upwards in the furnace. During this process the ore is reduced to iron by the reaction with this rising carbon monoxide.

The following questions are based on the extraction of iron from its ore:

12.2 Write the chemical formula for the main iron ore used to produce iron. (2)

12.3 Write a balanced chemical equation for the reaction using your answer in QUESTION 12.2 in the above process. (3)

12.4 Name the major impurity in iron ore. (2)

12.5 When air, water and other surrounding substances react with iron, it is corroded. Name this process. (2)

12.6 Suggest TWO methods by which the corrosion referred to in QUESTION 12.5 can be prevented or minimized. (2)

[13]

**QUESTION 13**

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 green house 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 former French President, Jacques Chirac]**

- 13.1 Research has shown that the temperature on earth is gradually rising. What term has been given to this phenomenon? (2)
- 13.2 Write THREE gases other than CO<sub>2</sub> that are responsible for the phenomenon in QUESTION 13.1. (3)
- 13.3 Explain briefly how greenhouse gases such as carbon dioxide heat up the earth's surface. (2)
- 13.4 Suggest TWO ways how you can help to reduce the emissions of greenhouse gases. (2)

**[9]**

**TOTAL SECTION B: 125**

**GRAND TOTAL: 150**