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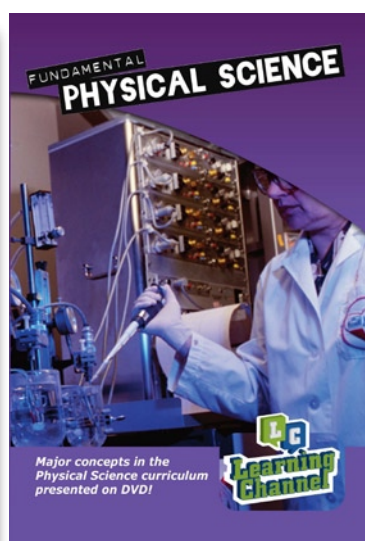
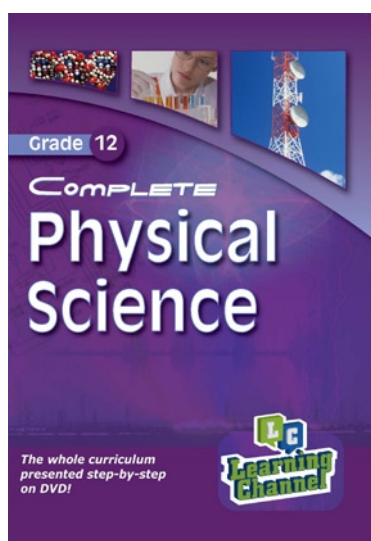
# **National Senior Certificate**

## **Grade 12**

# **Physical Science**

## **Paper 2**

**Other products for Physical Science available from Learning Channel:**



**INSTRUCTIONS AND INFORMATION**

1. Write your centre number and examination number in the spaces on the ANSWER BOOK.
  2. Answer ALL the questions.
  3. This question paper consists of TWO sections:  
SECTION A (25)  
SECTION B (125)
  4. Answer SECTION A and 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. Data sheets are attached for your use.
  9. Give brief motivations, discussions, etc. where required.
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**SECTION A****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 to 1.5) in the ANSWER BOOK.

- 1.1 The group with the ending **oic** in organic chemistry. (1)
- 1.2 The reaction which produces sodium hydroxide as a by-product. (1)
- 1.3 If the conditions (temperature, pressure, concentration) of an equilibrium system are changed, the system will react in such a way as to cancel the effect of that change. (1)
- 1.4 The process where electrical energy is converted into chemical energy. (1)
- 1.5 When an organic compound has the same molecular formula but different structural formula. (1)

**[5]****QUESTION 2: FALSE ITEMS**

Each of the five statements below is FALSE. Correct each statement so that it is TRUE. Write only the correct statement next to the question number (2.1 to 2.5) in the ANSWER BOOK.

NOTE: Correction by using the negative of the statement, for example "... IS NOT ...", will not be accepted.

- 2.1 Fertiliser mixed in the ratio 3:1:5 (38%) contains 2.6% phosphorus. (2)
- 2.2 A cell with the capacity 2 Ah produces 2 C. (2)
- 2.3 The melting points and boiling points of alkanes decrease with increasing molecular mass. (2)
- 2.4 The salt bridge of a Zn/Cu electrochemical cell can have a saturated sugar solution in it. (2)
- 2.5 The equilibrium constant is affected by concentration, temperature and pressure. (2)

**[10]****QUESTION 3: MULTIPLE-CHOICE QUESTIONS**

Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A to D) next to the question number (3.1 to 3.5) in the ANSWER BOOK.

- 3.1 Several drops of bromine solution are added to separate test-tubes containing samples of two different hydrocarbons marked A and B. Solution A becomes colourless immediately on shaking the test-tube. Test-tube B decolourises slowly on shaking. Intense UV light on solution B is found to speed up the reaction.

Which of the following statements is correct?

- A Hydrocarbon A is saturated and undergoes an addition reaction with bromine.
- B Hydrocarbon B is unsaturated and undergoes a substitution reaction.
- C Moist blue litmus held over the mouth of test-tube B turns pink as hydrogen bromide is evolved.

- D Moist blue litmus paper held over test-tube A will turn pink as a gas is evolved. (2)

3.2 Consider the following reactions with a metal M.

- (i) M reacts with a solution of silver nitrate causing a deposit of metallic silver to occur.  
 (ii) M does not react with a solution of zinc sulphate.

The correct way to list the metals M, Ag and Zn in order of decreasing strength as reducing agents is:

- A M, Ag, Zn  
 B Zn, M, Ag  
 C Ag, M, Zn  
 D Ag, Zn, M (2)

3.3 Which of the following structures is not an isomer of the other three?

- A 2,2 dimethyl but-1-ene  
 B 2,4 dimethyl pent-1-ene  
 C hex-2-ene  
 D 2 methyl pent-2-ene (2)

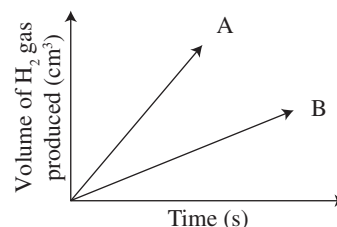
3.4 Which statements regarding the membrane used in a membrane cell is not true?

- A It is permeable to  $\text{Na}^+$  ions.  
 B It is used to keep  $\text{Cl}_2$  gas and  $\text{OH}^-$  ions apart.  
 C It is permeable to anions.  
 D It is permeable to water. (2)

3.5 Hydrogen gas may be prepared by the reaction of zinc metal with dilute hydrochloric acid. The chemical equation for this reaction is:



A learner determined the volume of hydrogen produced with time at two temperatures and two grades of Zn; powder and solid pellets. He used the same mass of zinc and the same volume and concentration of hydrochloric acid for each experiment and plotted graphs A and B above.



Which combination of temperature and surface area will be represented by A?

|   | Temperature | State of Zn |
|---|-------------|-------------|
| A | High        | Pellets     |
| B | High        | Powder      |
| C | Low         | Pellets     |
| D | Low         | Powder      |

(2)

[5 × 2 = 10]

SECTION A: TOTAL = [25]

**SECTION B****QUESTION 4**

There are many antacid tablets available on the market today to help relieve the pain of indigestion, which is caused by an increase in the acidity level in the stomach. Pain relief relies on the neutralisation reaction between the antacid and the hydrochloric acid in the stomach. The active ingredient in the antacid tablet is calcium carbonate, which reacts with the hydrochloric acid in the stomach according to the reaction:



Students investigated the reaction of a leading brand of antacid. They set up an experiment that collected the carbon dioxide gas released, and measured the volume of gas collected every half minute. The results of the experiment are shown below:

| Time (minutes) | Volume of gas (cm <sup>3</sup> ) |
|----------------|----------------------------------|
| 0              | 0                                |
| 0.5            | 5                                |
| 1              | 18                               |
| 1.5            | 24                               |
| 2              | 28                               |
| 2.5            | 31                               |
| 3              | 33                               |
| 3.5            | 34                               |
| 4              | 35                               |
| 4.5            | 35.5                             |
| 5              | 36                               |
| 5.5            | 36                               |

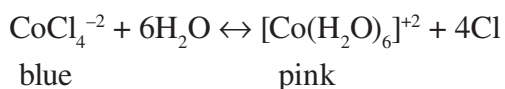
- 4.1.1 What is their independent variable? (1)
- 4.1.2 What is their dependent variable? (1)
- 4.1.3 State two relevant variables that they will need to control (keep fixed). (2)
- 4.1.4 State a suitable hypothesis for their investigation and briefly give a reason for the hypothesis based on the collision theory. (2)
- 4.1.5 Plot a graph of gas production versus time on the graph paper provided. (6)
- 4.2 The students repeated the experiment with the same antacid tablet, but used a lower concentration of acid. Will a graph of this experiment (on the same set of axes as in 4.1.5) be BELOW, ABOVE or THE SAME as the graph of 4.1.5? Give reasons for your answer. Also state what will happen to the final volume of gas produced in this experiment in comparison with that produced in 4.1.5. (4)
- 4.3 The students repeated the experiment with the same antacid tablet, but crushed it. Will a graph of this experiment (on the same set of axes as in 4.1.5) be BELOW, ABOVE or THE SAME as the original graph of 4.1.5? Give reasons for your answer. Also state what will happen to the final volume of gas produced in this experiment in comparison with that in 4.1.5. (4)
-

- 4.4 At what time did the original reaction run to completion? (1)
- 4.5 Look at how much gas was made during the first, second and third minute of the reaction. What do these numbers indicate about how the rate of reaction is changing with time? Use the collision theory to explain your answer. (3)
- 4.6 If the mass of calcium carbonate in one antacid tablet is 700 mg (0,7 g) then calculate the volume of  $0,1 \text{ mol.dm}^{-3}$  hydrochloric acid that would be neutralised by one tablet. (6)

**[30]**

## QUESTION 5

A group of learners want to investigate their hypothesis for the equilibrium system



They dissolved  $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$  crystals in **ethanol**, which resulted in a blue solution. They then slowly added water until the solution just turned pink, which indicated that the equilibrium system as shown above, was established.

**The learners stated that the forward reaction is endothermic.**

They made the following observations:

- A When adding more cobalt (II) chloride crystals to the pink solution, the solution turned blue.
  - B When water was added to the blue solution, the solution turned pink.
  - C When adding concentrated HCl to the pink solution, the solution turned blue.
  - D When the pink solution was heated, the solution turned blue.
- 5.1 State le Chateliers principle. (2)
- 5.2 Were the learners correct? Is the forward reaction endothermic? Explain. (4)
- 5.3 With reference to the above reaction state how the following factors will affect product yield and the value of the equilibrium constant.

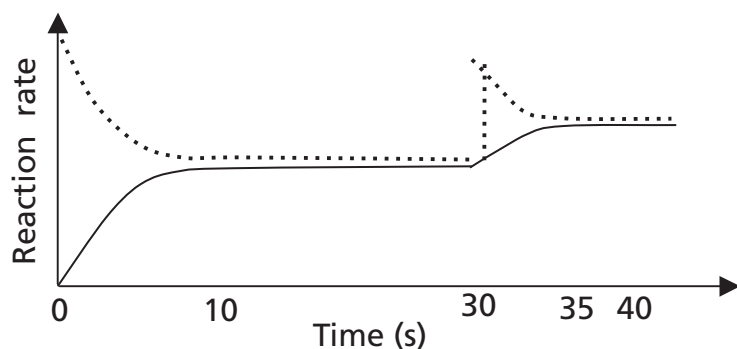
Write down the respective letter and next to the letter, one of the following: **increase, decrease, no effect.**

| Factor                                   | Product yield | Equilibrium constant |
|------------------------------------------|---------------|----------------------|
| Increase the $\text{Cl}^-$ concentration | a             | b                    |
| Cool the system                          | c             | d                    |
| Addition of a catalyst                   | e             | f                    |

(6)

- 5.4 Briefly explain your answers a, c and e in 5.3 (3)
- 5.5 Write down the  $K_c$  expression for the reaction. (2)
- 5.6 What does a  $K_c$  value tell you about a reaction? (2)

5.7



Look at the graph above and answer the questions that follow:

- 5.7.1 How many seconds did it take for the reaction to reach equilibrium for the first time? (1)
- 5.7.2 Give an equation for the reverse reaction. (1)
- 5.7.3 Using the observations made by the learners, explain what happened at 30 seconds. (4)
- 5.7.4 If a catalyst was added, explain how it will affect the equilibrium. (2)

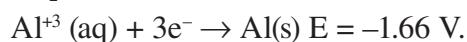
**[27]**

## QUESTION 6

The most common silver artifacts recovered from shipwrecks are 'silver' coins. In the 17<sup>th</sup>–19<sup>th</sup> centuries, there were many Dutch East Indiaman wrecks around the African coast. The silver coins recovered by treasure hunters have been found to contain between 95% silver to 60% silver. Other major elements include copper. The chemical coating on retrieved silver coins contains silver sulphide due to the anaerobic bacteria found in the mud. Methods for converting silver corrosion products to metallic silver all employ reducing reactions for the silver compounds. Electrolysis is the most common method used.

- 6.1 What energy conversion takes place in electrolysis? (1)
- 6.2 What is a reducing agent? (1)
- 6.3 State the direction of electron flow in the external circuit of the cell. (2)
- 6.4 Draw a labelled diagram to illustrate this procedure using electrodes, a silver coin coated with silver sulphide and a stainless steel electrode. A dilute solution of sodium hydroxide was used as an electrolyte. Oxygen gas is produced at one electrode. (5)
- 6.5 Given the following half reactions:
- $$2\text{H}_2\text{O}(\text{l}) \rightarrow \text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) + 4\text{e}^-$$
- $$\text{Ag}_2\text{S}(\text{s}) + 2\text{e}^- \rightarrow 2\text{Ag}(\text{s}) + \text{S}^{2-}(\text{aq})$$
- 6.5.1 Write down the oxidation half reaction. (1)
- 6.5.2 Write down the reaction that occurs at the cathode. (1)
- 6.5.3 Which electrode is negative? (1)
- 6.5.4 Write down the balanced ionic equation. (2)

- 6.6 Another reaction, galvanic reduction, is also used. The coin is wrapped in aluminium foil and covered with a formic acid solution with the following half reactions:



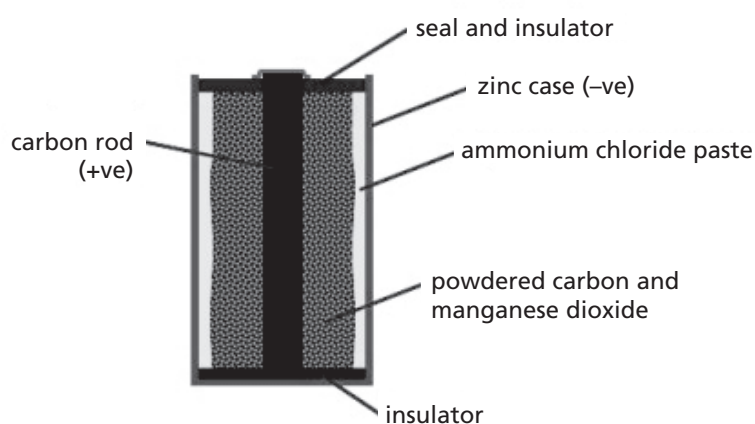
Use the given data to explain the coin cleaning process.

(4)

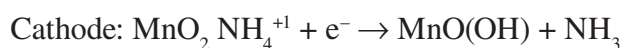
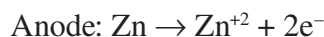
[18]

## QUESTION 7

The most common battery that is bought in shops is the zinc-carbon dry cell. It also is known as the Leclanche cell after its inventor, Georges Leclanche (1839–1882). Below is a representation of the cell.



These cells normally provide an emf of 1,5 V each. The reaction that takes place in the cell can be represented as:



- 7.1 What energy conversion takes place inside the cell. (1)
- 7.2 Is this a primary or a secondary cell? (1)
- 7.3 What is the difference between a primary and a secondary cell? (2)
- 7.4 What does the cell capacity measure? (2)
- 7.5 What is the current in the circuit if a cell has a capacity of 50 Ah and is run for 5 hours before going flat? (3)
- 7.6 Why does the temperature at which a cell is stored influence its capacity? (4)
- 7.7 List three specific uses of these types of cells. (3)
- 7.8 List two positive and two negative impacts of batteries on human society and on the environment. (4)

[20]

## QUESTION 8

|   |                                                     |   |                                                                    |
|---|-----------------------------------------------------|---|--------------------------------------------------------------------|
| A | $C_3H_8$                                            | F | $CH_3COOCH_3$                                                      |
| B | 2-pentene                                           | G | $CH_3CH_2CH_2F$                                                    |
| C | $\begin{array}{c} O \\    \\ CH_3CCH_3 \end{array}$ | H | $\begin{array}{c} CH_3 \\   \\ CH_3CCH_3 \\   \\ CH_3 \end{array}$ |
| D | $CH_3CH_2CH_2OH$                                    | I | $CH_3CH_2CH_2CH_2COOH$                                             |
| E | $CH_3CH_2CH_2CH_2CH_3$                              | J | 1,2-dibromobutane                                                  |

- 8.1 Which of the above is a saturated hydrocarbon? (1)
- 8.2 Which of the above are isomers of each other? (1)
- 8.3 J is formed when an alkene reacts with bromine. Give a balanced chemical equation for this reaction and name the type of reaction that occurs. (3)
- 8.4 If D and I react with each other, give the name of the product(s) formed. (2)
- 8.5 To which group does C belong? Name C. (2)
- 8.6 Give an isomer for your answer in 8.4. (1)
- 8.7 Consider compound F,
- 8.7.1 Write down the IUPAC name of this compound. (2)
- 8.7.2 Write down the names of the **two** organic compounds that were used to prepare this compound. (2)
- 8.7.3 Write down the structural formula **and** IUPAC name of one isomer of this compound. (3)
- 8.7.4 Name the catalyst required for this reaction. (1)

**[18]**

**QUESTION 9**

The table shows the boiling points of the first six alkanes and the first six alcohols.

| Alkane  | Boiling point (°C) |  | Alcohol    | Boiling Point (°C) |
|---------|--------------------|--|------------|--------------------|
| methane | −164               |  | Methanol   | 65                 |
| ethane  | −89                |  | ethanol    | 79                 |
| propane | −42                |  | 1-propanol | 97                 |
| butane  | −0,5               |  | 1-butanol  | 117                |
| pentane | 36                 |  | 1-pentanol | 138                |
| hexane  | 69                 |  | 1-hexanol  | 156                |

Study the table and then answer the questions that follow:

- 9.1 Alkanes are suitable as fuels and so are alcohols. What chemical properties do they both have that makes them so important to the fuel industry? (2)
- 9.2 Study the alkanes and their respective boiling points. What trend do you notice? Explain your answer. (3)
- 9.3 What type of bond is observed in alcohols? (1)
- 9.4 Use your answers in 9.2 and 9.3 to explain why alcohols have higher boiling points compared to alkanes. (3)
- 9.5 Write an equation for the combustion of methane. (3)

**[12]**