education

Department:
Education
REPUBLIC OF SOUTH AFRICA

# SENIOR CERTIFICATE EXAMINATION - 2006

## PHYSICAL SCIENCE PAPER 2
## CHEMISTRY

## HIGHER GRADE

## OCTOBER/NOVEMBER 2006

## 304-1/2E

PHYSICAL SCIENCE HG: Paper 2
Chemistry

304 1 2E HG

**MARKS: 200**

**TIME: 2 hours**

**This question paper consists of 15 pages, a data sheet of 4 pages and 1 multiple-choice answer sheet.**



GAUTENG

## GENERAL INSTRUCTIONS

1. Answer ALL the questions.
2. Non-programmable calculators may be used.
3. Appropriate mathematical instruments may be used.
4. A data sheet is provided for your use.

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## QUESTION 1

## INSTRUCTIONS

1. Answer this question on the specially printed ANSWER SHEET. (Write your EXAMINATION NUMBER in the appropriate space.) *[NOTE: This instruction may vary, depending on the type of answer book used by the province.]*
2. Use a PENCIL when making the necessary cross on your answer sheet.
3. In the case of a wrong answer, erase the pencil marks completely.
4. Do not make any other marks on your answer sheet. Any calculations or writing that may be necessary when answering this question should be done in the answer book and must be clearly deleted by means of a diagonal line drawn across the page.
   PLACE THE COMPLETED ANSWER SHEET INSIDE THE FRONT COVER OF YOUR ANSWER BOOK. *[NOTE: This instruction may vary, depending on the type of answer book used by the province.]*
5. Four possible answers, indicated by A, B, C and D, are supplied with each question. Choose only that answer, which in your opinion, is the correct or best one and mark the appropriate block on your answer sheet with a cross.
6. Each question has only one correct answer.
7. If more than one block is marked, no marks will be awarded for that answer.

EXAMPLE

**QUESTION:** The symbol for the unit of time is ...

A t.
B h.
C s.
D m.

**ANSWER:**

| A | B | C | D |
|---|---|---|---|

1.1 The temperature of an enclosed gas is defined as a measure of the ...

A number of gas molecules present in the sample.

B average kinetic energy of the gas molecules.

C number of collisions in the container.

D density of the gas molecules. (4)

1.2 A fixed mass of oxygen gas is sealed in a syringe at a certain temperature and pressure. The gas has a volume V. If both the pressure and the Kelvin temperature are now doubled, the volume of the gas will be ...

A V.

B ½ V.

C 2 V.

D 4 V. (4)

1.3 Hydrogen chloride is prepared by reacting NaCℓ with concentrated sulphuric acid. Which ONE of the following explains why HBr and HI cannot be prepared in the same way? The sulphuric acid ...

A only reacts with NaCℓ.

B is too strong for the reaction.

C oxidises HBr and HI to $Br_2$ and $I_2$ respectively.

D reduces HBr and HI to $Br_2$ and $I_2$ respectively. (4)

1.4 Concentrated nitric acid ($HNO_3$) is carefully heated in a test-tube, and it decomposes. Which ONE of the following is NOT a product of this reaction?

A $O_2$

B NO

C $NO_2$

D $H_2O$ (4)

1.5 The emf of a cell used in a hearing aid is +1,16 V. If one of the components of the cell is a zinc electrode, which half reaction occurs at the other electrode when the cell is in operation?

A $Zn^{2+} + 2e^- \rightarrow Zn$

B $O_2(g) + 2H^+ + 2e^- \rightarrow H_2O_2$

C $4OH^- \rightarrow 2H_2O + O_2 + 4e^-$

D $2H_2O + O_2 + 4e^- \rightarrow 4OH^-$ (4)

1.6 When hydrogen sulphide ($H_2S$) is bubbled through a solution of potassium dichromate ($K_2Cr_2O_7$), the colour of the solution changes from orange to green.

Which ONE of the half-reactions in the table below best explains the colour change?

| | Half reaction | Type of reaction |
|---|---|---|
| A | $H_2S \rightarrow S + 2H^+ + 2e^-$ | Reduction |
| B | $S + 2H^+ + 2e^- \rightarrow H_2S$ | Oxidation |
| C | $2Cr^{3+} + 7H_2O \rightarrow Cr_2O_7^{2-} + 14H^+ + 6e^-$ | Oxidation |
| D | $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$ | Reduction |

(4)

1.7 A sodium hydroxide solution of concentration 0,1 mol.dm$^{-3}$ is added dropwise to an ethanoic acid solution of concentration 0,1 mol.dm$^{-3}$. Which one of the following substances will increase in concentration as sodium hydroxide is added dropwise?

A $H_3O^+$

B $OH^-$

C $CH_3COO^-$

D $H_2O$ (4)

1.8 The reaction below has reached equilibrium at a temperature of 313 K in a closed syringe.

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

The pressure is then decreased at 313 K by increasing the volume.

Which ONE of the following is correct?

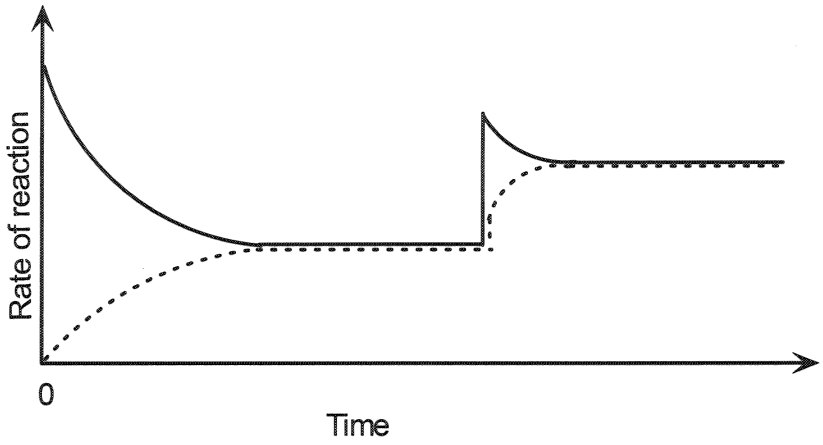
| | Amount of $N_2O_4$ | Amount of $NO_2$ | Change in $K_c$ |
|---|---|---|---|
| A | Increases | Decreases | Increases |
| B | Decreases | Increases | Increases |
| C | Decreases | Decreases | Decreases |
| D | Decreases | Increases | Stays the same |

(4)

1.9 The decomposition reaction of a hypothetical compound $AX_3(g)$, which is represented by the equation below, first reaches equilibrium in a closed container at a temperature $T_1$.

$$2AX_3(g) \rightleftharpoons 2AX_2(g) + X_2(g)$$

When the temperature is increased the system regains equilibrium at temperature $T_2$. The changes in the rate of this reaction are represented in the graph below:




Which ONE of the following statements is correct?

| | Conclusion | Change in $K_c$ |
|---|---|---|
| A | The reaction is exothermic. | $K_c$ at $T_1$ < $K_c$ at $T_2$ |
| B | The reaction is exothermic. | $K_c$ at $T_1$ > $K_c$ at $T_2$ |
| C | The reaction is endothermic. | $K_c$ at $T_1$ < $K_c$ at $T_2$ |
| D | The reaction is endothermic. | $K_c$ at $T_1$ > $K_c$ at $T_2$ |

(4)

1.10 A standard electrochemical cell is based on the following hypothetical half-reactions:

$$M + 3e^- \rightleftharpoons M^{3-} \qquad E^\circ = -2,5\ V$$

$$N^{2+} + 2e^- \rightleftharpoons N \qquad E^\circ = +1,5\ V$$

Which ONE of the following will be the strongest reducing agent?

A $M^{3-}$

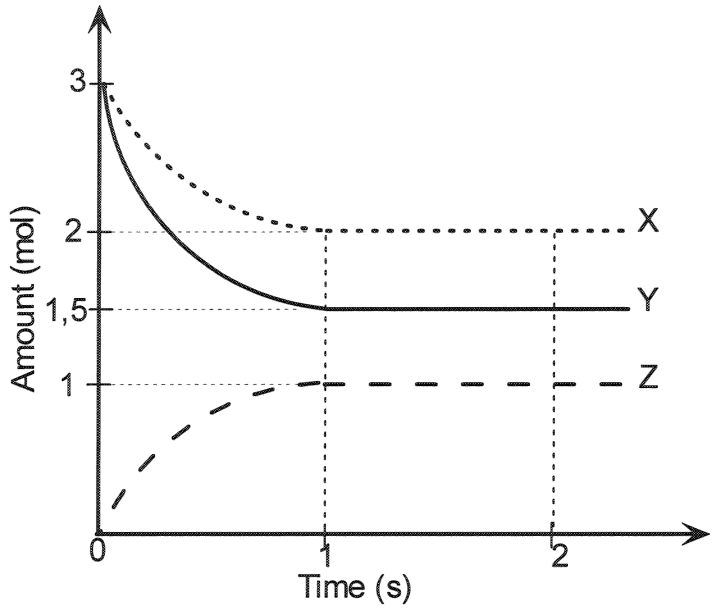
B $N^{2+}$

C M

D N

(4)

1.11 The graph below shows the changes in the amounts of X, Y and Z with time during a reaction.




The equation for the reaction can be represented as follows:

A $X + Y \rightarrow Z$

B $5X + 3Y \rightarrow 2Z$

C $3X + 3Y \rightarrow Z$

D $2X + 3Y \rightarrow 2Z$ (4)

1.12 A learner spilled some battery acid (sulphuric acid) on the garage floor and she wanted to add a chemical substance from her kitchen, which would neutralise the acid. Which ONE of the following substances would be the most suitable and least hazardous (harmful) to use?

| | SUBSTANCE | pH |
|---|---|---|
| A | Vinegar | 4 |
| B | Lemon juice | 5 |
| C | Sodium bicarbonate | 8 |
| D | Sodium hydroxide | 13 |

(4)

1.13 Chloroform is added to a colourless solution of potassium iodide (KI) in a test tube. Chlorine gas ($C\ell_2$) is then bubbled through the solution. The chloroform layer in the test tube turns purple. Which ONE of the following statements is CORRECT?

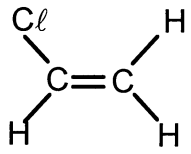
A The iodide ions donate electrons to chlorine gas.

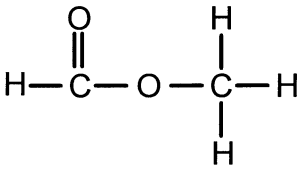
B The iodide ions form a purple complex with chloroform.

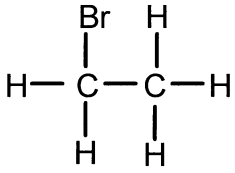
C The $C\ell_2$ gas is a reducing agent.

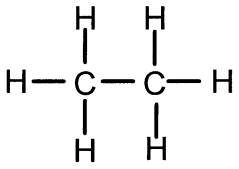
D The chloroform oxidizes the iodide ions. (4)

1.14 Which ONE of the following compounds can exist as an isomer?

A 

B 

C 

D 

(4)

1.15 An example of an unsaturated hydrocarbon is:

A $C_2HC\ell_3$

B $C_3H_6$

C $C_2H_6$

D $C_2H_5OH$

(4)

**[60]**

**ANSWER QUESTIONS 2 - 9 IN YOUR ANSWER BOOK.**

**INSTRUCTIONS**

1. Start each question on a NEW page in your answer book.
2. Leave one line open between sub-sections, for example between QUESTIONS 2.1 and 2.2.
3. Give ALL formulae used and show your workings (this includes substitutions).
4. Number your answers in the same way that the questions are numbered.

**QUESTION 2**

A fixed mass of pure nitrogen gas is placed in a calibrated syringe. The plunger of the syringe is free to move.

The syringe is now placed in a beaker with ice. (See the diagram).

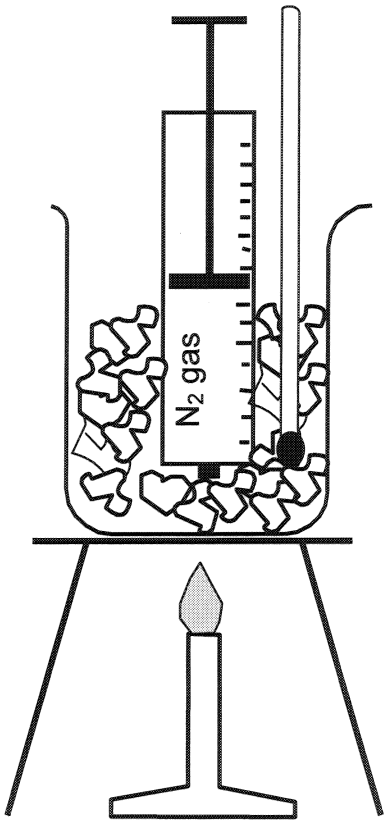
The temperature and the volume of the gas in the syringe are noted after 10 minutes.

Thereafter the contents of the beaker are slowly heated with a bunsen flame.

The temperature and volume readings are recorded at 10-minute intervals.

A graph of volume versus temperature is plotted.

The boiling point of nitrogen is –196 °C.




2.1 Write down the name of the forces that exist between the following:

2.1.1 The water molecules (1)

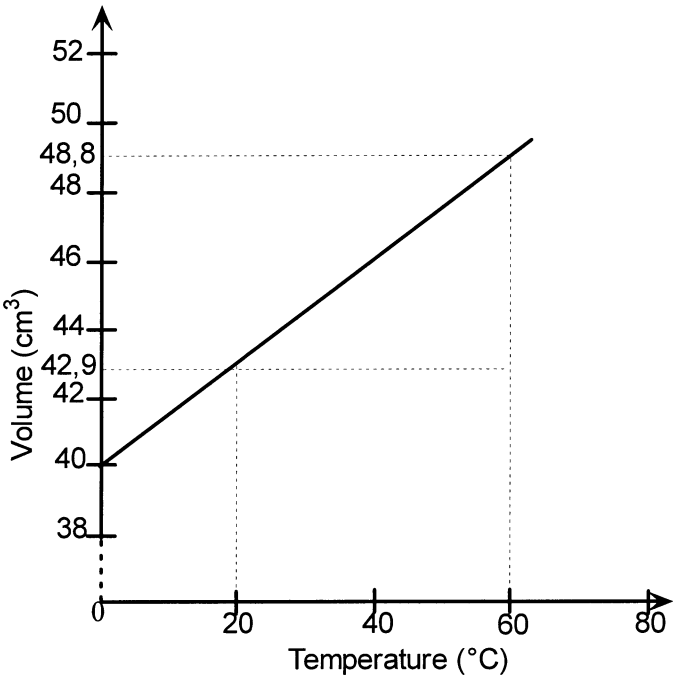
2.1.2 The molecules of nitrogen gas (1)

2.2 Which factor was kept constant during this experiment? Choose ONE from temperature, pressure or volume. (1)

2.3 How does the factor in QUESTION 2.2 remain constant? (2)

2.4 Explain why the volume and temperature are noted at 10-minute intervals and not at 1-minute intervals. (2)

2.5 The following graph was drawn from the results obtained:




2.5.1 At which temperature was the volume of the gas 40 $cm^3$? (1)

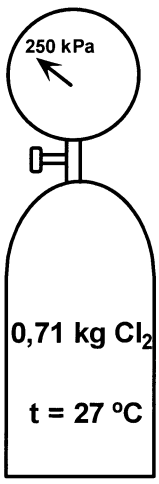
2.5.2 A learner argued that the volume of the gas at 80 °C can be obtained by extrapolating from the graph.

2.5.2.1 Why is it reasonable to assume that extrapolation will give the correct volume at 80 °C? (2)

2.5.2.2 Explain why it will not be reasonable to assume that the volume of the gas at –210 °C can be obtained by extrapolation from the graph. (2)

2.5.2.3 The learner found the volume of the gas at 80 °C to be approximately 52 $cm^3$ by extrapolation. Perform a calculation to verify the learner's answer. (4)

2.6 Calculate the volume of a steel container, in $m^3$, if the pressure gauge on the container shows a reading of 250 kPa when 0,71 kg $C\ell_2(g)$ is enclosed in the container at 27 °C.

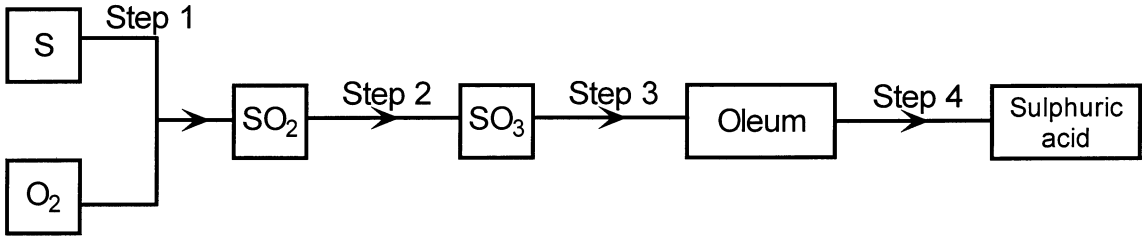



(7)

**[23]**

**QUESTION 3 (Start on a new page)**

3.1 Some of the steps in the industrial preparation of sulphuric acid are outlined below.




3.1.1 Write down a balanced equation for the reaction leading to the formation of $SO_3$ in Step 2. (2)

3.1.2 In which step is a catalyst used? (1)

3.1.3 Write down the name of the catalyst used in QUESTION 3.1.2. (2)

3.1.4 Write down a reason why sulphuric acid is not obtained directly by dissolving $SO_3$ in water. (2)

3.1.5 A typical reaction of sulphuric acid is indicated below:

$$C_6H_{12}O_6(s) \xrightarrow{H_2SO_4\ (conc)} 6C(s) + 6H_2O(\ell)$$

What chemical property of $H_2SO_4$ does this demonstrate? (2)

3.2 A white shirt has been stained by writing ink (dye). It is dipped into chlorine water (containing $HOC\ell$) to remove the stain. The equation for the reaction in this process is given below:

$$dye + HOC\ell(aq) \rightarrow HC\ell(aq) + dye + X$$

3.2.1 Write down the correct formula for substance X. (2)

3.2.2 Write down the name of the oxidising agent in this reaction. (2)

3.2.3 Write down an equation to show what happens when chlorine gas is bubbled through water. (3)

**[16]**

**QUESTION 4 (Start on a new page)**

Two learners investigate the reaction between copper turnings and concentrated nitric acid using the apparatus in FIGURE 1.

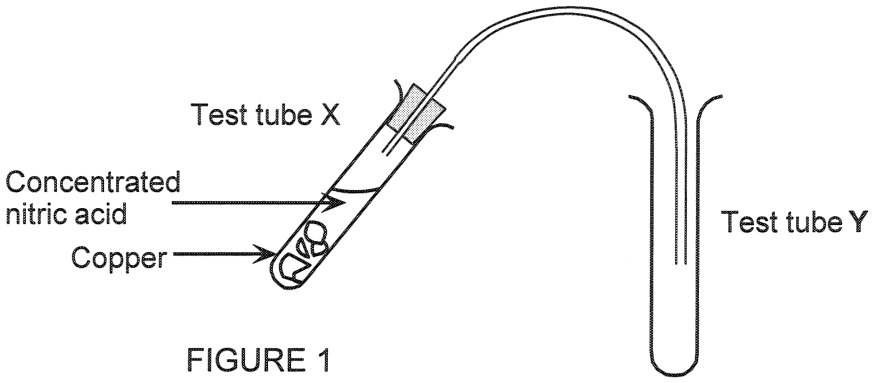



FIGURE 1

4.1 Write down the following:

4.1.1 TWO observations they can make about the reaction in test tube X (2)

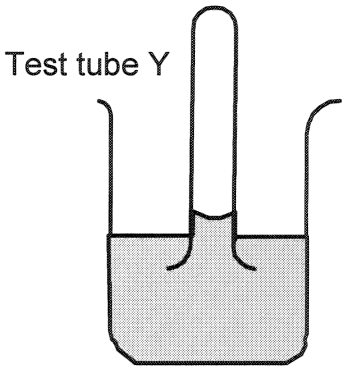
4.1.2 An observation they can make about the contents in test tube Y (1)

4.2 Write down the formula for the ion that is associated with the colour of the solution in test tube X. (2)

4.3 Classify the reaction that takes place in test tube X.
(Choose from: REDOX, NEUTRALISATION or PRECIPITATION reaction.) (2)

*They place the mouth of test tube Y below the surface of cold water, as indicated in the diagram.*

*They observe that the water moves slightly upwards into the test tube.*




4.4 Why does the water rise in the test tube? (2)

4.5 Is the solution in the beaker now neutral, acidic or basic? (2)

*One of the learners conducts another experiment with the same apparatus as in FIGURE 1 but this time he uses a <u>dilute</u> nitric acid solution and copper turnings.*

4.6 For the reaction between the dilute nitric acid and the copper turnings in test tube X, write down the following:
(Use the Table of Standard Reduction Potentials.)

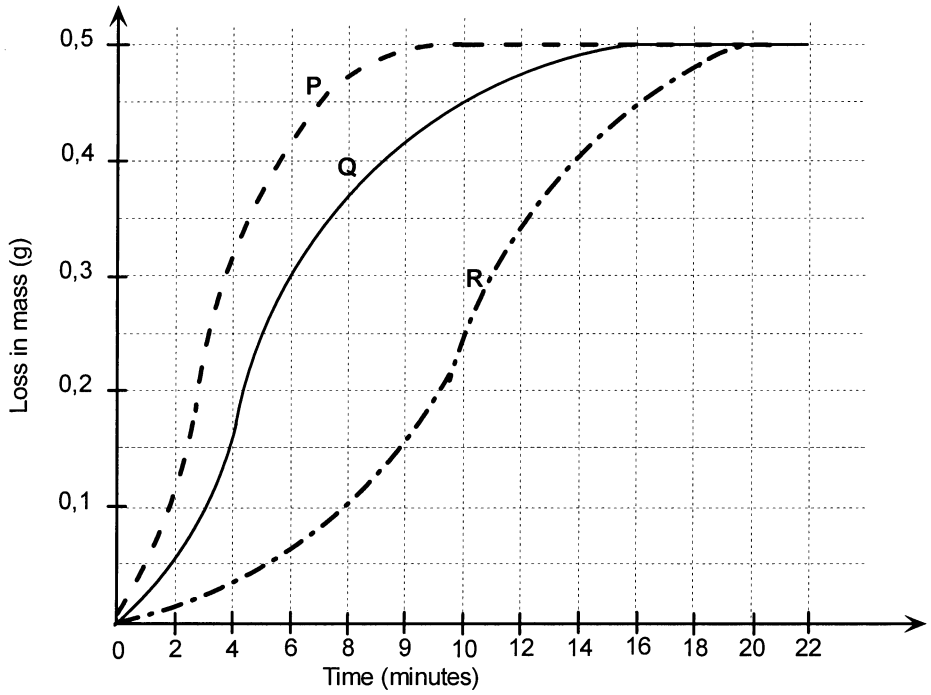
4.6.1 The reduction half reaction (2)

4.6.2 The balanced equation for the reaction that takes place (3)

**[16]**

**QUESTION 5 (Start on a new page)**

Marble chips ($CaCO_3$) of mass 1,05 g were placed in a flask and covered with 10 $cm^3$ of a 2 $mol.dm^{-3}$ hydrochloric acid solution at 20 °C. The flask was weighed at two-minute intervals to determine the loss in mass caused by the production of carbon dioxide. A graph labelled Q was drawn from the results. Use this graph to answer the questions that follow:




5.1 Write a balanced equation for the reaction between the marble chips and hydrochloric acid. (3)

5.2 What mass of carbon dioxide was formed after 18 minutes? (2)

5.3 During which ONE of the following time intervals was the reaction the fastest?
(Choose from: *0-2 minutes, 2-4 minute, 8-10 minutes or 16-18 minutes.*) (2)

5.4 After how many minutes had only half of the $CaCO_3$ reacted? (2)

5.5 Predict what will happen to the rate of production of carbon dioxide in the following cases: (Choose from: INCREASES, DECREASES or STAYS THE SAME.)

5.5.1 The marble chips are ground to powder (2)

5.5.2 A 20 $cm^3$ sample of a 2 $mol.dm^{-3}$ hydrochloric acid solution is used (2)

*The experiment is now repeated by increasing the temperature of the HCℓ solution from 20 °C to 30 °C.*

5.6 Which graph, P,Q or R, will be obtained from these results? (2)
**[15]**

## QUESTION 6 (Start on a new page)

6.1 Two (2) moles of nitrogen dioxide gas ($NO_2$) and 2 moles of sulphur dioxide gas ($SO_2$) are allowed to react in a closed container of volume 2 $dm^3$ and at a temperature of 700 °C. After *t* seconds an analysis of the mixture showed that 0,75 moles of $SO_3$ were present in the container. At 700 °C $K_c$ = 9. The equation for the equilibrium reaction is:

$$NO_2(g) + SO_2(g) \rightleftharpoons SO_3(g) + NO(g)$$

Is the reaction in equilibrium at *t* seconds? Clearly show how you arrived at your answer. (9)

6.2 After a period of time the temperature is increased and an analysis showed that the $K_c$ value has increased to 12. Make use of Le Chatelier's principle to determine whether the forward reaction is exothermic or endothermic. (4)

**[13]**

## QUESTION 7 (Start on a new page)

A learner is provided with 50 $cm^3$ of dilute sulphuric acid with a concentration of 0,2 $mol.dm^{-3}$. Assume complete ionisation of the acid.

7.1 What is meant by a dilute acid solution? (2)

7.2 The learner uses X grams of potassium hydroxide to prepare a 100 $cm^3$ potassium hydroxide solution in a conical flask. She then adds all the sulphuric acid solution to the conical flask containing potassium hydroxide at 25 °C.

The pH of the resulting solution is 12,8.

7.2.1 Which of the ions, $OH^-$ or $H^+$, is in excess in the resulting solution? (1)

7.2.2 Calculate the number of moles of ions in excess in the resulting solution. (7)

7.2.3 Determine the mass X of the potassium hydroxide used. (8)

7.3 A few crystals of ammonium nitrate are added to distilled water in a test tube and a solution is formed.

7.3.1 Is the solution ACIDIC, BASIC or NEUTRAL? (2)

7.3.2 Write down an ionic equation that will explain the answer to QUESTION 7.3.1. (3)

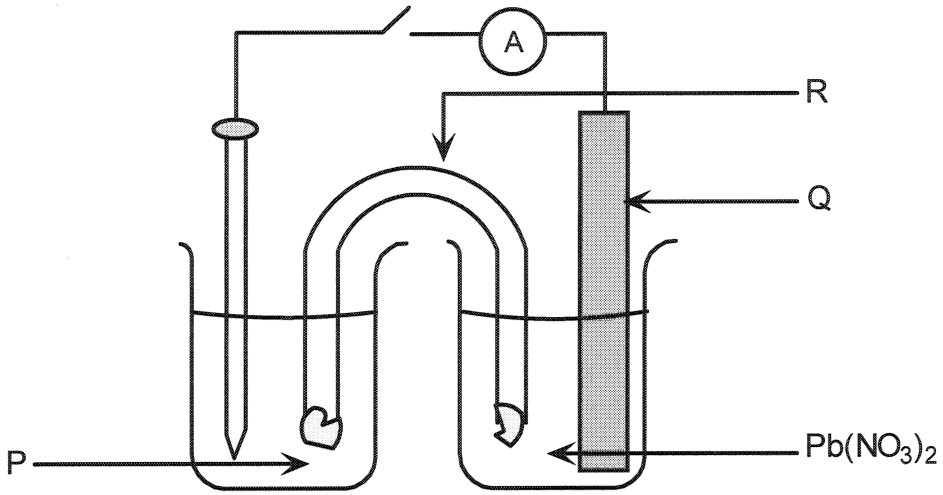
**[23]**

**QUESTION 8 (Start on a new page)**

When iron nails are placed in lead(II) nitrate solution, a reaction takes place.

8.1 Write down the oxidation half-reaction. (2)

8.2 A standard electrochemical cell is set up using an iron nail and a 1 $mol.dm^{-3}$ lead(II) nitrate solution.




Write down the chemical formula/symbol for the following:

8.2.1 The solution labelled P (1)

8.2.2 The solid labelled Q (1)

8.2.3 The solution found in R (1)

8.3 If the cell is delivering a current for some time, what will happen to the following?
(Write down only INCREASES, DECREASES or STAYS THE SAME.)

8.3.1 The mass of the iron nail (1)

8.3.2 The concentration of electrolyte P (1)

8.3.3 The mass of electrode Q (1)

8.4 Give a reason for your answer to QUESTION 8.3.3. (2)

8.5 The positive ions move from the salt bridge towards electrode Q.
Give a reason why this occurs. (2)

8.6 Write down the balanced equation for the reaction that takes place when the cell is in operation. (3)
**[15]**

**QUESTION 9 (Start on a new page)**

9.1 Consider the following organic compounds represented by the letters A to E:

A $CHC\ell_3$

B $CH_3COOH$

C $C_2H_5OH$

D $C_2H_4$

E $CH_3COOCH_3$

For the questions below write down the letter of the correct answer only.

Which ONE of the compounds will:

9.1.1 Neutralise a solution of sodium carbonate (2)

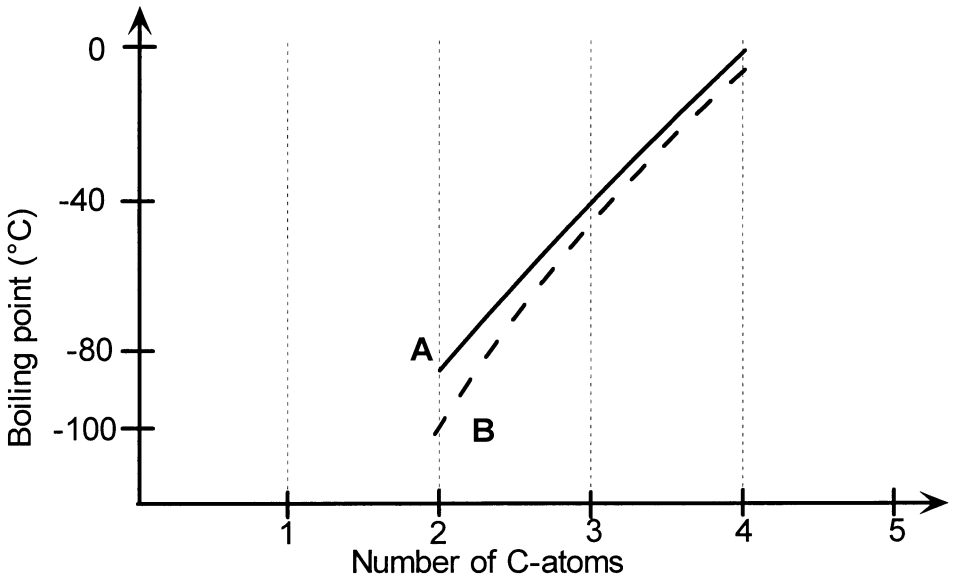
9.1.2 Form an ester when reacting with an organic acid (2)

9.1.3 Undergo bromination (2)

9.1.4 Be the initial product of fermentation (2)

9.1.5 Act as an anaesthetic (2)

9.2 The graphs below show the relationship between the boiling points and the number of carbon atoms in the first few saturated and unsaturated hydrocarbons.




9.2.1 What is the trend in the boiling points as the number of carbon atoms increases? (2)

9.2.2 Explain the trend referred to in QUESTION 9.2.1. (3)

9.2.3 Which of the graphs, A or B, is that of the saturated hydrocarbons? (1)

9.2.4 Give a reason for the answer to QUESTION 9.2.3. (3)

**[19]**

**TOTAL: 200**

# DEPARTMENT OF EDUCATION
# *DEPARTEMENT VAN ONDERWYS*

## SENIOR CERTIFICATE EXAMINATION
## *SENIORSERTIFIKAAT-EKSAMEN*

## DATA FOR PHYSICAL SCIENCE
## PAPER 2 (CHEMISTRY)

## *GEGEWENS VIR NATUUR- EN SKEIKUNDE*
## *VRAESTEL 2 (CHEMIE)*

### TABLE 1: PHYSICAL CONSTANTS
### *TABEL 1: FISIESE KONSTANTES*

| | | |
|---|---|---|
| Avogadro's constant<br>*Avogadro-konstante* | $N_A$ or / of $L$ | $6{,}02 \times 10^{23}$ mol$^{-1}$ |
| Molar gas constant<br>*Molêre gaskonstante* | $R$ | 8,31 J.K$^{-1}$.mol$^{-1}$ |
| Standard pressure<br>*Standaarddruk* | $p^{\theta}$ | $1{,}013 \times 10^{5}$ Pa |
| Molar gas volume at STP<br>*Molêre gasvolume by STD* | $V_m$ | 22,4 dm$^3$.mol$^{-1}$ |
| Standard temperature<br>*Standaardtemperatuur* | $T^{\theta}$ | 273 K |

### TABLE 2: FORMULAE
### *TABEL 2: FORMULES*

| | |
|---|---|
| $\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$ | $\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$ |
| $pV = nRT$ | $K_w = [\mathrm{H}^+][\mathrm{OH}^-] = 10^{-14}$ at/*by* 298 K |
| $n = \frac{m}{M}$ | $pH = -\log[\mathrm{H}^+]$ |
| $c = \frac{n}{V}$ | $E^{\theta}_{\text{cell}} = E^{\theta}_{\text{oxidising agent}} - E^{\theta}_{\text{reducing agent}}$ |
| | $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$ |
| $c = \frac{m}{MV}$ | $E^{\theta}_{\text{cell}} = E^{\theta}_{\text{cathode}} - E^{\theta}_{\text{anode}}$ |
| | $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$ |

## TABLE 3: THE PERIODIC TABLE OF ELEMENTS
## *TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE*

**KEY/*SLEUTEL***

Atomic number
*Atoomgetal*

Electronegativity
*Elektronegatiwiteit*

Symbol
*Simbool*

Relative atomic mass (approximately)
*Relatiewe atoommassa (benaderd)*

| I | II | III | IV | V | VI | VII | 0 |
|---|---|---|---|---|---|---|---|
| 1 H 2,1 1 | | | | | | | 2 He 4 |
| 3 Li 1,0 7 | 4 Be 1,5 9 | 5 B 2,0 11 | 6 C 2,5 12 | 7 N 3,0 14 | 8 O 3,5 16 | 9 F 4,0 19 | 10 Ne 20 |
| 11 Na 0,9 23 | 12 Mg 1,2 24 | 13 Aℓ 1,5 27 | 14 Si 1,8 28 | 15 P 2,1 31 | 16 S 2,5 32 | 17 Cℓ 3,0 35,5 | 18 Ar 40 |
| 19 K 0,8 39 | 20 Ca 1,0 40 | 21 Sc 1,3 45 | 22 Ti 1,5 48 | 23 V 1,6 51 | 24 Cr 1,6 52 | 25 Mn 1,5 55 | 26 Fe 1,8 56 |
| 27 Co 1,8 59 | 28 Ni 1,8 59 | 29 Cu 1,9 63,5 | 30 Zn 1,6 65 | 31 Ga 1,6 70 | 32 Ge 1,8 73 | 33 As 2,0 75 | 34 Se 2,4 79 |
| 35 Br 2,8 80 | 36 Kr 84 | | | | | | |
| 37 Rb 0,8 86 | 38 Sr 1,0 88 | 39 Y 1,2 89 | 40 Zr 1,4 91 | 41 Nb 92 | 42 Mo 1,8 96 | 43 Tc 1,9 | 44 Ru 2,2 101 |
| 45 Rh 2,2 103 | 46 Pd 2,2 106 | 47 Ag 1,9 108 | 48 Cd 1,7 112 | 49 In 1,7 115 | 50 Sn 1,8 119 | 51 Sb 1,9 122 | 52 Te 2,1 128 |
| 53 I 2,5 127 | 54 Xe 131 | | | | | | |
| 55 Cs 0,7 133 | 56 Ba 0,9 137 | 57 La 139 | 72 Hf 1,6 179 | 73 Ta 181 | 74 W 184 | 75 Re 186 | 76 Os 190 |
| 77 Ir 192 | 78 Pt 195 | 79 Au 197 | 80 Hg 201 | 81 Tℓ 1,8 204 | 82 Pb 1,8 207 | 83 Bi 1,9 209 | 84 Po 2,0 |
| 85 At 2,5 | 86 Rn | | | | | | |
| 87 Fr 0,7 | 88 Ra 0,9 226 | 89 Ac | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58 Ce 140 | 59 Pr 141 | 60 Nd 144 | 61 Pm | 62 Sm 150 | 63 Eu 152 | 64 Gd 157 | 65 Tb 159 | 66 Dy 163 | 67 Ho 165 | 68 Er 167 | 69 Tm 169 | 70 Yb 173 | 71 Lu 175 |
| 90 Th 232 | 91 Pa | 92 U 238 | 93 Np | 94 Pu | 95 Am | 96 Cm | 97 Bk | 98 Cf | 99 Es | 100 Fm | 101 Md | 102 No | 103 Lr |

## TABLE 4A: STANDARD REDUCTION POTENTIALS
## *TABEL 4A: STANDAARD REDUKSIEPOTENSIALE*

Increasing oxidising ability / *Toenemende oksideervermoë* ↑

↓ Increasing reducing ability / *Toenemende reduseervermoë*

| Half-reaction / *Halfreaksie* | E° /volt |
|---|---|
| $F_2 + 2e^- \rightleftharpoons 2F^-$ | +2,87 |
| $H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$ | +1,77 |
| $MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$ | +1,51 |
| $Au^{3+} + 3e^- \rightleftharpoons Au$ | +1,42 |
| $C\ell_2 + 2e^- \rightleftharpoons 2C\ell^-$ | +1,36 |
| $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$ | +1,33 |
| $O_2 + 4H^+ + 4e^- \rightleftharpoons 2H_2O$ | +1,23 |
| $MnO_2 + 4H^+ + 2e^- \rightleftharpoons Mn^{2+} + 2H_2O$ | +1,21 |
| $Pt^{2+} + 2e^- \rightleftharpoons Pt$ | +1,20 |
| $Br_2 + 2e^- \rightleftharpoons 2Br^-$ | +1,09 |
| $NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO + 2H_2O$ | +0,96 |
| $Ag^+ + e^- \rightleftharpoons Ag$ | +0,80 |
| $NO_3^- + 2H^+ + e^- \rightleftharpoons NO_2 + H_2O$ | +0,80 |
| $Hg^{2+} + 2e^- \rightleftharpoons Hg$ | +0,79 |
| $Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$ | +0,77 |
| $O_2 + 2H^+ + 2e^- \rightleftharpoons H_2O_2$ | +0,68 |
| $I_2 + 2e^- \rightleftharpoons 2I^-$ | +0,54 |
| $SO_2 + 4H^+ + 4e^- \rightleftharpoons S + 2H_2O$ | +0,45 |
| $2H_2O + O_2 + 4e^- \rightleftharpoons 4OH^-$ | +0,40 |
| $Cu^{2+} + 2e^- \rightleftharpoons Cu$ | +0,34 |
| $SO_4^{2-} + 4H^+ + 2e^- \rightleftharpoons SO_2 + 2H_2O$ | +0,17 |
| $Cu^{2+} + e^- \rightleftharpoons Cu^+$ | +0,16 |
| $Sn^{4+} + 2e^- \rightleftharpoons Sn^{2+}$ | +0,15 |
| $S + 2H^+ + 2e^- \rightleftharpoons H_2S$ | +0,14 |
| **$2H^+ + 2e^- \rightleftharpoons H_2$** | **0,00** |
| $Fe^{3+} + 3e^- \rightleftharpoons Fe$ | -0,04 |
| $Pb^{2+} + 2e^- \rightleftharpoons Pb$ | -0,13 |
| $Sn^{2+} + 2e^- \rightleftharpoons Sn$ | -0,14 |
| $Ni^{2+} + 2e^- \rightleftharpoons Ni$ | -0,25 |
| $Co^{2+} + 2e^- \rightleftharpoons Co$ | -0,28 |
| $Cd^{2+} + 2e^- \rightleftharpoons Cd$ | -0,40 |
| $Fe^{2+} + 2e^- \rightleftharpoons Fe$ | -0,44 |
| $Cr^{3+} + 3e^- \rightleftharpoons Cr$ | -0,74 |
| $Zn^{2+} + 2e^- \rightleftharpoons Zn$ | -0,76 |
| $2H_2O + 2e^- \rightleftharpoons H_2 + 2OH^-$ | -0,83 |
| $Mn^{2+} + 2e^- \rightleftharpoons Mn$ | -1,18 |
| $A\ell^{3+} + 3e^- \rightleftharpoons A\ell$ | -1,66 |
| $Mg^{2+} + 2e^- \rightleftharpoons Mg$ | -2,37 |
| $Na^+ + e^- \rightleftharpoons Na$ | -2,71 |
| $Ca^{2+} + 2e^- \rightleftharpoons Ca$ | -2,87 |
| $Sr^{2+} + 2e^- \rightleftharpoons Sr$ | -2,89 |
| $Ba^{2+} + 2e^- \rightleftharpoons Ba$ | -2,90 |
| $Cs^+ + e^- \rightleftharpoons Cs$ | -2,92 |
| $K^+ + e^- \rightleftharpoons K$ | -2,93 |
| $Li^+ + e^- \rightleftharpoons Li$ | -3,05 |

## TABLE 4B: STANDARD REDUCTION POTENTIALS
## *TABEL 4B: STANDAARD REDUKSIEPOTENSIALE*

| Half-reaction / Halfreaksie | | | E° /volt |
|---|---|---|---|
| $Li^+$ | + $e^-$ ⇌ | Li | -3,05 |
| $K^+$ | + $e^-$ ⇌ | K | -2,93 |
| $Cs^+$ | + $e^-$ ⇌ | Cs | -2,92 |
| $Ba^{2+}$ | + $2e^-$ ⇌ | Ba | -2,90 |
| $Sr^{2+}$ | + $2e^-$ ⇌ | Sr | -2,89 |
| $Ca^{2+}$ | + $2e^-$ ⇌ | Ca | -2,87 |
| $Na^+$ | + $e^-$ ⇌ | Na | -2,71 |
| $Mg^{2+}$ | + $2e^-$ ⇌ | Mg | -2,37 |
| $A\ell^{3+}$ | + $3e^-$ ⇌ | $A\ell$ | -1,66 |
| $Mn^{2+}$ | + $2e^-$ ⇌ | Mn | -1,18 |
| $2H_2O$ | + $2e^-$ ⇌ | $H_2 + 2OH^-$ | -0,83 |
| $Zn^{2+}$ | + $2e^-$ ⇌ | Zn | -0,76 |
| $Cr^{3+}$ | + $3e^-$ ⇌ | Cr | -0,74 |
| $Fe^{2+}$ | + $2e^-$ ⇌ | Fe | -0,44 |
| $Cd^{2+}$ | + $2e^-$ ⇌ | Cd | -0,40 |
| $Co^{2+}$ | + $2e^-$ ⇌ | Co | -0,28 |
| $Ni^{2+}$ | + $2e^-$ ⇌ | Ni | -0,25 |
| $Sn^{2+}$ | + $2e^-$ ⇌ | Sn | -0,14 |
| $Pb^{2+}$ | + $2e^-$ ⇌ | Pb | -0,13 |
| $Fe^{3+}$ | + $3e^-$ ⇌ | Fe | -0,04 |
| **$2H^+$** | **+ $2e^-$** ⇌ | **$H_2$** | **0,00** |
| $S + 2H^+$ | + $2e^-$ ⇌ | $H_2S$ | +0,14 |
| $Sn^{4+}$ | + $2e^-$ ⇌ | $Sn^{2+}$ | +0,15 |
| $Cu^{2+}$ | + $e^-$ ⇌ | $Cu^+$ | +0,16 |
| $SO_4^{2-} + 4H^+$ | + $2e^-$ ⇌ | $SO_2 + 2H_2O$ | +0,17 |
| $Cu^{2+}$ | + $2e^-$ ⇌ | Cu | +0,34 |
| $2H_2O + O_2$ | + $4e^-$ ⇌ | $4OH^-$ | +0,40 |
| $SO_2 + 4H^+$ | + $4e^-$ ⇌ | $S + 2H_2O$ | +0,45 |
| $I_2$ | + $2e^-$ ⇌ | $2I^-$ | +0,54 |
| $O_2 + 2H^+$ | + $2e^-$ ⇌ | $H_2O_2$ | +0,68 |
| $Fe^{3+}$ | + $e^-$ ⇌ | $Fe^{2+}$ | +0,77 |
| $Hg^{2+}$ | + $2e^-$ ⇌ | Hg | +0,79 |
| $NO_3^- + 2H^+$ | + $e^-$ ⇌ | $NO_2 + H_2O$ | +0,80 |
| $Ag^+$ | + $e^-$ ⇌ | Ag | +0,80 |
| $NO_3^- + 4H^+$ | + $3e^-$ ⇌ | $NO + 2H_2O$ | +0,96 |
| $Br_2$ | + $2e^-$ ⇌ | $2Br^-$ | +1,09 |
| $Pt^{2+}$ | + $2e^-$ ⇌ | Pt | +1,20 |
| $MnO_2 + 4H^+$ | + $2e^-$ ⇌ | $Mn^{2+} + 2H_2O$ | +1,21 |
| $O_2 + 4H^+$ | + $4e^-$ ⇌ | $2 H_2O$ | +1,23 |
| $Cr_2O_7^{2-} + 14H^+$ | + $6e^-$ ⇌ | $2Cr^{3+} + 7H_2O$ | +1,33 |
| $C\ell_2$ | + $2e^-$ ⇌ | $2C\ell^-$ | +1,36 |
| $Au^{3+}$ | + $3e^-$ ⇌ | Au | +1,42 |
| $MnO_4^- + 8H^+$ | + $5e^-$ ⇌ | $Mn^{2+} + 4H_2O$ | +1,51 |
| $H_2O_2 + 2H^+$ | + $2e^-$ ⇌ | $2H_2O$ | +1,77 |
| $F_2$ | + $2e^-$ ⇌ | $2F^-$ | +2,87 |

**Increasing oxidising ability / *Toenemende oksideervermoë*** ↓

↑ **Increasing reducing ability / *Toenemende reduseervermoë***

# ANSWER SHEET
# *ANTWOORDBLAD*

**PHYSICAL SCIENCE HG (SECOND PAPER)/*NATUUR- EN SKEIKUNDE HG (TWEEDE VRAESTEL)***

| **Examination number** *Eksamennommer* | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

## DEPARTMENT OF EDUCATION
## *DEPARTEMENT VAN ONDERWYS*

**SENIOR CERTIFICATE EXAMINATION** ***SENIORSERTIFIKAAT-EKSAMEN***

## PHYSICAL SCIENCE HIGHER GRADE SECOND PAPER (CHEMISTRY)
## *NATUUR- EN SKEIKUNDE HOËR GRAAD TWEEDE VRAESTEL (CHEMIE)*

| | | | | |
|---|---|---|---|---|
| **1.1** | A | B | C | D |
| **1.2** | A | B | C | D |
| **1.3** | A | B | C | D |
| **1.4** | A | B | C | D |
| **1.5** | A | B | C | D |
| **1.6** | A | B | C | D |
| **1.7** | A | B | C | D |
| **1.8** | A | B | C | D |
| **1.9** | A | B | C | D |
| **1.10** | A | B | C | D |
| **1.11** | A | B | C | D |
| **1.12** | A | B | C | D |
| **1.13** | A | B | C | D |
| **1.14** | A | B | C | D |
| **1.15** | A | B | C | D |

| Vir die gebruik van die nasiener<br>For the use of the marker | |
|---|---|
| Marks obtained<br>Punte behaal | |
| Marker's initials<br>Nasiener se paraaf | |
| Marker's number<br>Nasiener se nommer | |