education

Department:
Education
REPUBLIC OF SOUTH AFRICA

# NATIONAL SENIOR CERTIFICATE

## GRADE 12

## PHYSICAL SCIENCES: CHEMISTRY (P2)

## ADDITIONAL EXEMPLAR 2008

**MARKS: 150**

**TIME: 3 hours**

**This question paper consists of 16 pages, 4 data sheets, 1 answer sheet and 1 sheet of graph paper.**

## INSTRUCTIONS AND INFORMATION

1. Write your 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.

3. Answer SECTION A on the attached ANSWER SHEET.

4. Answer SECTION B in the ANSWER BOOK.
   Answer QUESTION 8.5 on the attached GRAPH PAPER.

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 and a periodic table are attached for your use.

9. Be brief wherever motivations, discussions, et cetera are required.

## 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 class of hydrocarbons of which the molecules contain a ring of six carbon atoms, with only one hydrogen atom (or other group) attached to each carbon atom (1)

1.2 The amount of heat energy absorbed or released during a particular chemical reaction (1)

1.3 The chemical process when an electric current is passed through an ionic compound in solution or in molten state (1)

1.4 The main ore from which aluminium is extracted (1)

1.5 The process by which nitrogen is obtained from air (1)
**[5]**

## QUESTION 2: MATCHING ITEMS

Choose an item from COLUMN B that matches a description in COLUMN A. Write only the letter (A – J) next to the question number (2.1 – 2.5) on the attached ANSWER SHEET.

| COLUMN A | | COLUMN B | |
|---|---|---|---|
| 2.1 | Carbonyl group | A | catalyst |
| 2.2 | A substance that provides an alternative reaction path for a reaction | B | $-NH_2$ |
| | | C | activated complex |
| 2.3 | Addition of hydrogen to an alkyne | D | $-\overset{\overset{O}{\|\|}}{C}-$ |
| 2.4 | The electrode in a galvanic cell at which reduction occurs | E | hydrogenation |
| 2.5 | Haber Process | F | cathode |
| | | G | hydration |
| | | H | ammonia |
| | | I | anode |
| | | J | nitric acid |

**[5]**

## QUESTION 3: TRUE/FALSE ITEMS

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (3.1 – 3.5) on the attached ANSWER SHEET. Correct the statement if it is FALSE.

3.1 The haloalkanes known as CFC's are no longer used in fire extinguishers and aerosol cans because they are expensive to manufacture. (2)

3.2 If the concentration of reactants increases, the total number of collisions also increases. (2)

3.3 When the reaction $CuO(s) + H_2(g) \rightleftharpoons Cu(s) + H_2O(g)$ is in equilibrium, then $K_c = \frac{[CuO][H_2]}{[Cu][H_2O]}$. (2)

3.4 An electrolytic cell converts mechanical energy to electrical energy. (2)

3.5 A battery labelled as 3 000 mA·h can deliver a current of 500 mA for 6 hours. (2)
**[10]**

## QUESTION 4: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and make a cross (X) in the block (A – D) next to the question number (4.1 – 4.5) on the attached ANSWER SHEET.

4.1 Which of the following are structural isomers of hexane?

(i) $CH_3—CH_2—CH(CH_2CH_3)—CH_2CH_3$

(ii) $CH_3—CH_2—CH_2—CH_2—CH(CH_3)—CH_2$

(iii) $CH_3—CH(CH_2—CH_3)—CH_2—CH_3$

A (i) and (ii) only

B (ii) and (iii) only

C (i), (ii) and (iii)

D (i) and (iii) only (3)

4.2 Which ONE of the following compounds will have the highest boiling point?

A $CH_3CH_2CH_2CH_2CH_3$ B $CH_3CH_2CH_2CH_2OCH_3$

C $CH_3CH_2CH_2CH_2CH_2OH$ D $CH_3CH_2CH_2C(=O)CH_3$ (3)

4.3 In which ONE of the following equilibrium reactions is the yield of products favoured by increasing the pressure of the reaction mixture?

A $2NO(g) + C\ell_2(g) \rightleftharpoons 2NOC\ell(g)$

B $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$

C $2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$

D $PC\ell_5(g) \rightleftharpoons PC\ell_3(g) + C\ell_2(g)$ (3)

4.4 Which ONE of the following half-reactions occurs at the cathode during the electrolysis of an aqueous $CuC\ell_2$ solution?

A $C\ell_2 + 2e^- \rightarrow 2C\ell^-$

B $Cu^+ + e^- \rightarrow Cu$

C $2C\ell^- \rightarrow C\ell_2 + 2e^-$

D $Cu^{2+} + 2e^- \rightarrow Cu$ (3)

4.5 Which ONE of the following containers can be used to store an iron(II) sulphate solution?

A Al

B Mg

C Ni

D Zn (3)

**[15]**

**TOTAL SECTION A: 35**

## SECTION B

## INSTRUCTIONS

1. Answer this section in the ANSWER BOOK.
2. In ALL calculations the formulae and substitutions must be shown.
3. Round off your answers to TWO decimal places where applicable.

## QUESTION 5

Hydrocarbons are simple organic compounds. The homologous series called alkanes is one group of hydrocarbons. One physical property of alkanes is shown in the table below.

| NAME | BOILING POINT (℃) | ISOMER | BOILING POINT OF ISOMER (℃) |
|---|---|---|---|
| methane | -161,0 | - | - |
| ethane | -88,5 | - | - |
| butane | -1 | methylpropane | -12 |
| pentane | 34 | 2-methylbutane | 28 |
| hexane | 68,7 | 2,3-dimethylbutane | 58 |

5.1 Define the concept *homologous series*. (2)

5.2 Explain the change in boiling points of the alkanes from methane to hexane. (2)

5.3 How do the boiling points of the straight chain compounds differ from that of their corresponding isomers? Give a reason for this difference. (3)

5.4 Write down the structural formula of the isomer of hexane shown in the table. (2)

5.5 The human body secretes oils that maintain the moisture of the skin. Alkanes, such as petrol and paint thinner, dissolve non-polar organic material such as fats and oils.

Explain why people must minimise contact with hydrocarbon solvents such as paint thinner. (2)

5.6 Petroleum jelly (Vaseline) is a soft semi-solid mixture of hydrocarbons that provides a protective film when used on the skin. It is hydrophobic (water repelling) and is, for example, used on burns or to prevent nappy rash on babies.

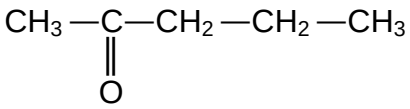
5.6.1 Which physical property of Vaseline explains why it does not flow like petrol? (1)

5.6.2 Boiling water is accidentally spilled on a child. Explain why Vaseline should not be used on the child's skin immediately after sustaining burns. (2)

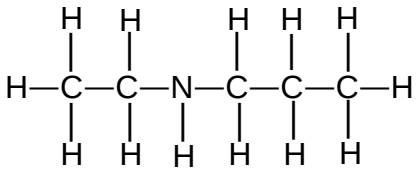
**[14]**

## QUESTION 6

Four organic compounds, labelled A, B, C and D, are shown below.

**A** 

**B** methylbenzene

**C** 

**D** 4-methyl-2-hexyne

6.1 Write down the structure of the functional group and the IUPAC name for compound **A.** (3)

6.2 Write down the IUPAC name of compound **C.** (2)

6.3 Write down the structural formula for compound **B.** (2)

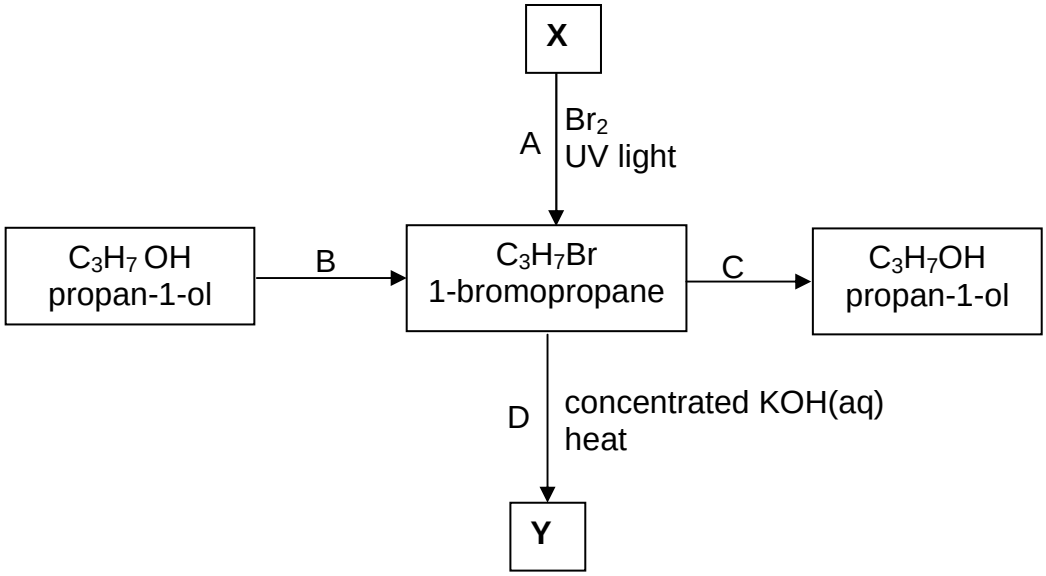
6.4 Describe a test that can be used to distinguish compound **D** from 4-methylhexane. (2)

6.5 Esters are a group of organic compounds widely known for their pleasant odours. The fruity smell of apple is, for example, due to the presence of ethyl butanoate.

Write down the condensed structural formula of ethyl butanoate. (2)
**[11]**

## QUESTION 7

Some organic reactions are shown in the flow diagram below.




7.1 Name the type of reactions illustrated by A, B, C and D. (4)

7.2 Use condensed structural formulae and write a balanced equation for reaction C. (3)

7.3 Write down the structural formula for compound **X**. (2)

7.4 In order to obtain product **Y**, $C_3H_7Br$ is heated with a concentrated solution of KOH under reflux. Use condensed structural formulae to write a balanced equation for the reaction. (3)

7.5 A group of learners decided to heat $C_3H_7Br$ with dilute sodium hydroxide, instead of the concentrated potassium hydroxide, under reflux. Write down the IUPAC name of the organic compound that they will obtain. (2)

**[14]**

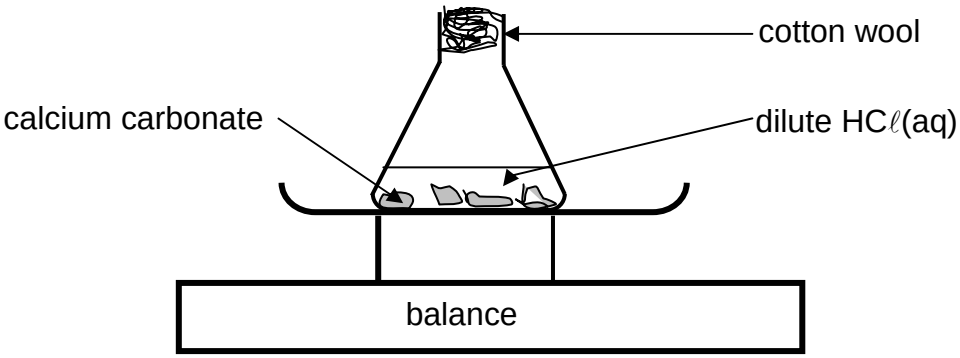
## QUESTION 8

A learner uses an excess of calcium carbonate chunks and dilute hydrochloric acid during a practical investigation. The following reaction takes place between the two reagents:

$$CaCO_3(s) + 2HC\ell(aq) \rightarrow CaC\ell_2(aq) + CO_2(g) + H_2O(\ell)$$

The learner provides the following information as part of her laboratory report:

- Set up the apparatus as shown in the diagram below.




- Place 20 g of the calcium carbonate into an Erlenmeyer flask and cover it with 50 $cm^3$ dilute hydrochloric acid.
- Record the mass of the flask and contents at 30 second time intervals.
- Repeat the experiment another two times. Use the same amount of calcium carbonate, but change the size of the calcium carbonate pieces each time by breaking the chunks into smaller particles. Keep the amount and concentration of the hydrochloric acid constant.

8.1 Write down the investigative question for this investigation. (2)

8.2 Apart from the initial mass of the calcium carbonate and the volume of acid, what initial measurement must the learner make? (1)

8.3 Why does the learner use the same amounts of calcium carbonate and hydrochloric acid during each experiment? (1)

8.4 In recording the time, what important precaution should the learner take? (1)

One set of readings obtained by the learner is shown below.

| **MASS OF $CO_2$ PRODUCED (g)** | 0 | 0,46 | 0,70 | 0,82 | 0,90 | 0,95 | 1,0 | 1,0 |
|---|---|---|---|---|---|---|---|---|
| **t (s)** | 0 | 60 | 120 | 180 | 240 | 300 | 360 | 420 |

8.5 Represent the above results on a graph. Use the attached GRAPH PAPER. (6)

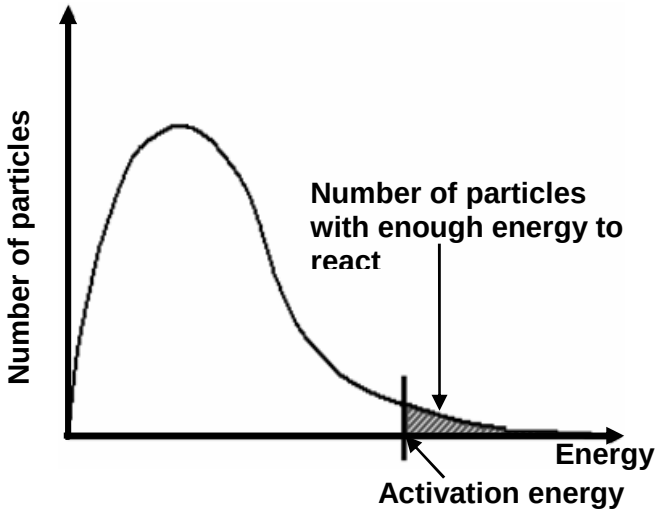
8.6 What conclusion can be drawn from the graph? (2)

**[13]**

## QUESTION 9

A catalyst speeds up the rate of a reaction. This behaviour of a catalyst can be explained in terms of the activation energy and the collision theory.

9.1 The diagram below shows the Maxwell-Boltzmann distribution curve for a certain reaction.




9.1.1 Explain in terms of the collision theory and activation energy, how a catalyst influences the rate of a reaction. (4)

9.1.2 Redraw the above distribution curve into the answer book and show the new activation energy when a catalyst is added to the reaction mixture on the diagram. (2)

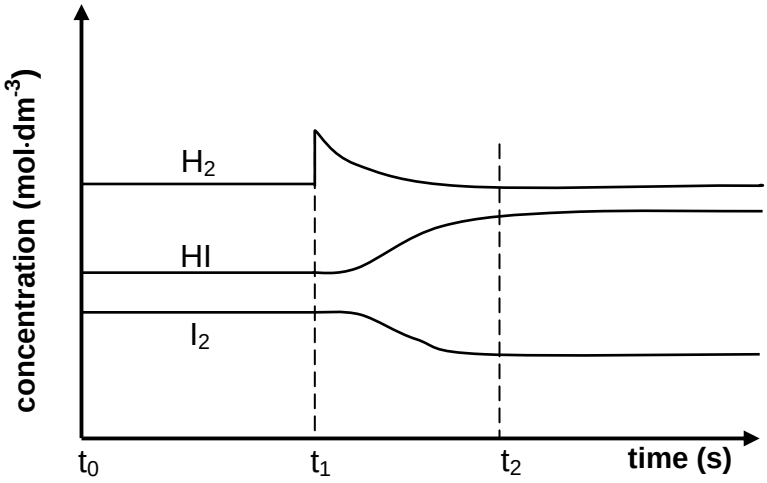
9.2 When milk is left at room temperature, it spoils rapidly. However, in a refrigerator, it stays fresh for a longer time. Use the collision theory to explain this observation. (3)
**[9]**

## QUESTION 10

10.1 Hydrogen and iodine are injected into a closed container at constant temperature. The reaction reaches equilibrium according to the following equation:

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

The graph below illustrates changes that were then made to the equilibrium mixture.




10.1.1 What information about the reaction can be obtained from the graph between times $t_0$ and $t_1$? (1)

10.1.2 Describe all the changes that occurred in the system between $t_1$ and $t_2$. (4)

10.1.3 Initially 0,3 mol of $H_2$ and 0,3 mol of $I_2$ is injected into the closed container of volume 2 $dm^3$. Equilibrium is established at 448 °C. The equilibrium constant ($K_c$) for the reaction at 448 °C is 50,5. Calculate the number of moles of HI produced at equilibrium. (8)

10.2 Atmospheric pressure reduces at high altitudes and consequently the amount of oxygen in the atmosphere is less than at sea level. Mountain climbers can experience hypoxia – a deficiency in oxygen. Symptoms of hypoxia include headache and nausea, and one may even slip into a coma.

The haemoglobin molecule (Hb) carries oxygen to the blood. In the process the oxygen bonds to the haemoglobin to form oxyhaemoglobin ($HbO_2$). A simplified equilibrium expression for the reaction is shown below.

$$Hb(aq) + O_2(aq) \rightleftharpoons HbO_2(aq)$$

10.2.1 What precaution must a mountain climber take in order to minimise the risk of hypoxia? (2)

10.2.2 Refer to the above equilibrium reaction and explain why the precaution stated in QUESTION 10.2.1 is necessary. (3) **[18]**

## QUESTION 11

11.1 A group of learners set up an electrochemical cell using lead and copper half cells.

11.1.1 Which ONE of copper or lead will be the negative electrode? Give a reason for your answer. (2)

11.1.2 Use the Table of Standard Reduction Potentials (Table 4A or 4B) and write down the reduction half-reaction that will take place in this cell. (2)

11.1.3 A 2 V bulb is connected to the cell. Will the bulb light up? Justify your answer with a calculation. (5)

11.1.4 A voltmeter is now connected to the cell instead of the bulb. It is observed that after a while the reading on the voltmeter drops to zero. We say the cell is 'flat' or 'dead'.

Explain this observation in terms of the concentrations of the solutions in the cell. (3)

11.2 A cell such as the one described above is not much useful. However, the principle is used in batteries for cars, torches, computers, et cetera. These batteries are called secondary cells.

One such battery is the mercury cell. The half reactions occurring in this cell are shown below.

$$Zn(s) + 2OH^-(aq) \rightarrow ZnO(s) + H_2O + 2e^- \ldots\ldots\ldots(1)$$

$$HgO(s) + H_2O + 2e^- \rightarrow Hg(\ell) + 2\ OH^-(aq) \ldots\ldots\ldots(2)$$

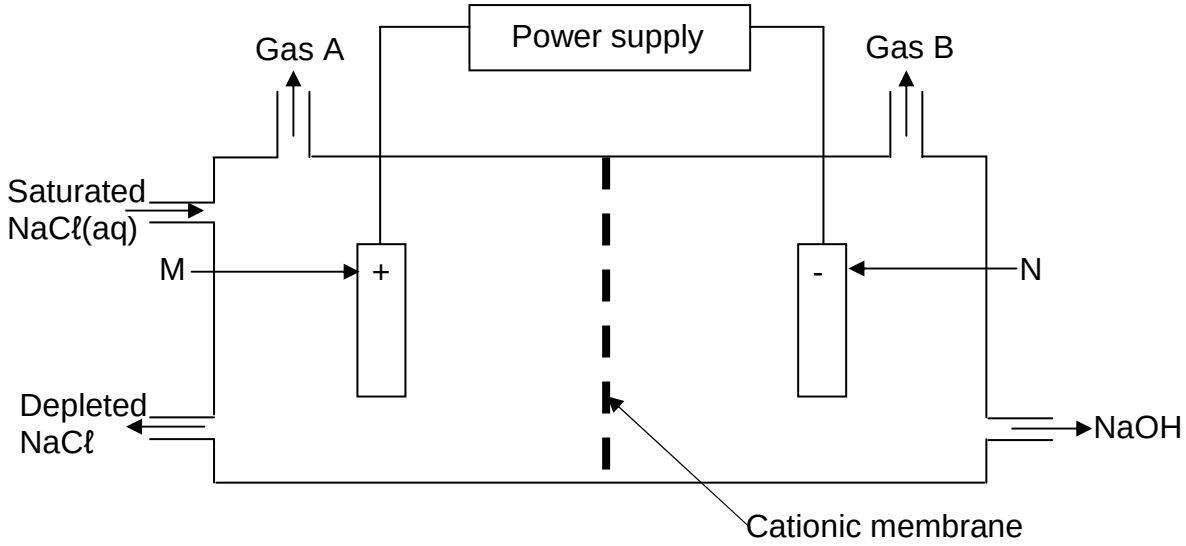
11.2.1 Write down the overall cell reaction. (2)

11.2.2 Why does the use of this battery pose an environmental hazard? (1)

**[15]**

## QUESTION 12

The diagram below shows a type of membrane cell used in the chloroalkali industry.




12.1 Name the gases A and B. (2)

12.2 Why is the membrane called a cationic membrane? (1)

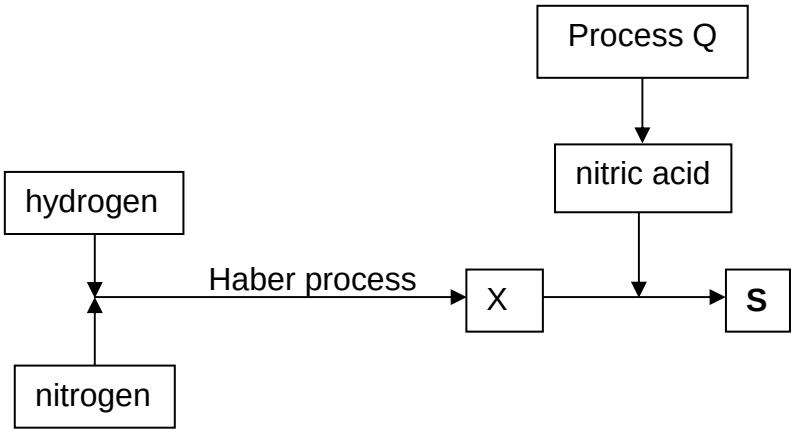
12.3 Write down the half-reaction that takes place at electrode N. (2)

12.4 Apart from its use in household products, name ONE industrial use of chlorine. (1)

12.5 Explain why this electrolytic process cannot be done in one large container without a membrane. (2)
**[8]**

## QUESTION 13

13.1 The flow diagram below shows processes and reactions that lead to the formation of a nitrogen-based fertiliser **S.**




13.1.1 Write down the NAME for product X. (1)

13.1.2 Write down the NAME for Process Q. (1)

13.1.3 Write down the FORMULA for fertiliser **S**. (2)

13.1.4 Write down the FORMULA for fertiliser **S** if the nitric acid is replaced with sulphuric acid. (2)

13.2 A farmer stores fertilisers with NPK ratios 4:5:8 and 13:5:9. The farmer wants to grow tomatoes and fruit.

13.2.1 Explain the meaning of *NPK ratio*. (2)

13.2.2 Which ONE of these fertilisers must he use? (1)

13.2.3 Give a reason for your answer to QUESTION 13.2.2. (2)

13.3 Overuse of nitrogen-based fertilisers creates problems for the environment and humans.

Name ONE threat posed by nitrogen-based fertilisers to the environment and ONE threat posed to humans. (2)
**[13]**

**TOTAL SECTION B: 115**

**GRAND TOTAL: 150**

# NATIONAL SENIOR CERTIFICATE
# *NASIONALE SENIOR SERTIFIKAAT*

## DATA FOR PHYSICAL SCIENCES GRADE 12
## PAPER 2 (CHEMISTRY)

## *GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12*
## *VRAESTEL 2 (CHEMIE)*

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

| NAME/*NAAM* | SYMBOL/*SIMBOOL* | VALUE/*WAARDE* |
|---|---|---|
| Standard pressure<br>*Standaarddruk* | $p^{\theta}$ | $1{,}013 \times 10^5$ Pa |
| Molar gas volume at STP<br>*Molêre gasvolume by STD* | $V_m$ | $22{,}4\ dm^3 \cdot mol^{-1}$ |
| Standard temperature<br>*Standaardtemperatuur* | $T^{\theta}$ | 273 K |

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

| | |
|---|---|
| $n = \frac{m}{M}$ | $c = \frac{n}{V}$ |
| $c = \frac{m}{MV}$ | $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$<br>$E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$<br>$E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$ |

NSC

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

| 1 (I) | 2 (II) | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 (III) | 14 (IV) | 15 (V) | 16 (VI) | 17 (VII) | 18 (VIII) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2,1 **1** **H** **1** | | | | | | | | | | | | | | | | | **2** **He** **4** |
| 1,0 **3** **Li** **7** | 1,5 **4** **Be** **9** | | | | | | | | | | | 2.0 **5** **B** **11** | 2.5 **6** **C** **12** | 3.0 **7** **N** **14** | 3.5 **8** **O** **16** | 4.0 **9** **F** **19** | **10** **Ne** **20** |
| 0,9 **11** **Na** **23** | 1,2 **12** **Mg** **24** | | | | | | | | | | | 1.5 **13** **Aℓ** **27** | 1.8 **14** **Si** **28** | 2.1 **15** **P** **31** | 2.5 **16** **S** **32** | 3.0 **17** **Cℓ** **35,5** | **18** **Ar** **40** |
| 0,8 **19** **K** **39** | 1,0 **20** **Ca** **40** | 1,3 **21** **Sc** **45** | 1.5 **22** **Ti** **48** | 1.6 **23** **V** **51** | 1.6 **24** **Cr** **52** | 1.5 **25** **Mn** **55** | 1.8 **26** **Fe** **56** | 1.8 **27** **Co** **59** | 1.8 **28** **Ni** **59** | 1.9 **29** **Cu** **63,5** | 1.6 **30** **Zn** **65** | 1.6 **31** **Ga** **70** | 1.8 **32** **Ge** **73** | 2.0 **33** **As** **75** | 2.4 **34** **Se** **79** | 2.8 **35** **Br** **80** | **36** **Kr** **84** |
| 0,8 **37** **Rb** **86** | 1,0 **38** **Sr** **88** | 1,2 **39** **Y** **89** | 1.4 **40** **Zr** **91** | **41** **Nb** **92** | 1.8 **42** **Mo** **96** | 1.9 **43** **Tc** | 2.2 **44** **Ru** **101** | 2.2 **45** **Rh** **103** | 2.2 **46** **Pd** **106** | 1.9 **47** **Ag** **108** | 1.7 **48** **Cd** **112** | 1.7 **49** **In** **115** | 1.8 **50** **Sn** **119** | 1.9 **51** **Sb** **122** | 2.1 **52** **Te** **128** | 2.5 **53** **I** **127** | **54** **Xe** **131** |
| 0,7 **55** **Cs** **133** | 0,9 **56** **Ba** **137** | **57** **La** **139** | 1.6 **72** **Hf** **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** | 1.8 **81** **Tℓ** **204** | 1.8 **82** **Pb** **207** | 1.9 **83** **Bi** **209** | 2.0 **84** **Po** | 2.5 **85** **At** | **86** **Rn** |
| 0,7 **87** **Fr** | 0,9 **88** **Ra** **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** |

**KEY/*SLEUTEL***

**Atomic number** *Atoomgetal*

**Electronegativity** *Elektronegatiwiteit*

1,9 **Cu** **Symbol** *Simbool*

29

63,5

**Approximate relative atomic mass** *Benaderde relatiewe atoommassa*

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

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↑

| Half-reactions/*Halfreaksies* | | | $E^{\theta}$ (V) |
|---|---|---|---|
| $F_2(g) + 2e^-$ | $\rightleftharpoons$ | $2F^-$ | + 2,87 |
| $Co^{3+} + e^-$ | $\rightleftharpoons$ | $Co^{2+}$ | + 1,82 |
| $MnO_4^- + 8H^+ + 5e^-$ | $\rightleftharpoons$ | $Mn^{2+} + 4H_2O$ | + 1,52 |
| $C\ell_2(g) + 2e^-$ | $\rightleftharpoons$ | $2C\ell^-$ | + 1,36 |
| $Cr_2O_7^{2-} + 14H^+ + 6e^-$ | $\rightleftharpoons$ | $2Cr^{3+} + 7H_2O$ | + 1,33 |
| $MnO_2 + 4H^+ + 2e^-$ | $\rightleftharpoons$ | $Mn^{2+} + 2H_2O$ | + 1,28 |
| $O_2(g) + 4H^+ + 3e^-$ | $\rightleftharpoons$ | $2H_2O$ | + 1,23 |
| $Br_2(\ell) + 2e^-$ | $\rightleftharpoons$ | $2Br^-$ | + 1,06 |
| $NO_3^- + 4H^+ + 3e^-$ | $\rightleftharpoons$ | $NO(g) + 2H_2O$ | + 0,96 |
| $Ag^+ + e^-$ | $\rightleftharpoons$ | $Ag$ | + 0,80 |
| $Hg^{2+} + 2e^-$ | $\rightleftharpoons$ | $Hg(\ell)$ | + 0,78 |
| $NO_3^- + 2H^+ + e^-$ | $\rightleftharpoons$ | $NO_2(g) + H_2O$ | + 0,78 |
| $Fe^{3+} + e^-$ | $\rightleftharpoons$ | $Fe^{2+}$ | + 0,77 |
| $O_2(g) + 2H^+ + 2e^-$ | $\rightleftharpoons$ | $H_2O_2$ | + 0,68 |
| $I_2 + 2e^-$ | $\rightleftharpoons$ | $2I^-$ | + 0,54 |
| $Cu^+ + e^-$ | $\rightleftharpoons$ | $Cu$ | + 0,52 |
| $SO_2 + 4H^+ + 2e^-$ | $\rightleftharpoons$ | $S + 2H_2O$ | + 0,45 |
| $2H_2O + O_2 + 4e^-$ | $\rightleftharpoons$ | $4OH^-$ | + 0,40 |
| $Cu^{2+} + 2e^-$ | $\rightleftharpoons$ | $Cu$ | + 0,34 |
| $SO_4^{2-} + 4H^+ + 4e^-$ | $\rightleftharpoons$ | $SO_2(g) + 2H_2O$ | + 0,17 |
| $Cu^{2+} + e^-$ | $\rightleftharpoons$ | $Cu^+$ | + 0,16 |
| $Sn^{4+} + 2e^-$ | $\rightleftharpoons$ | $Sn^{2+}$ | + 0,15 |
| $S + 2H^+ + 2e^-$ | $\rightleftharpoons$ | $H_2S(g)$ | + 0,14 |
| $2H^+ + 2e^-$ | $\rightleftharpoons$ | $H_2(g)$ | 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 |
| $Cr^{3+} + e^-$ | $\rightleftharpoons$ | $Cr^{2+}$ | – 0,41 |
| $Fe^{2+} + 2e^-$ | $\rightleftharpoons$ | $Fe$ | – 0,44 |
| $Cr^{3+} + 3e^-$ | $\rightleftharpoons$ | $Cr$ | – 0,74 |
| $Cr^{2+} + 2e^-$ | $\rightleftharpoons$ | $Cr$ | – 0,74 |
| $Zn^{2+} + 2e^-$ | $\rightleftharpoons$ | $Zn$ | – 0,76 |
| $2H_2O + 2e^-$ | $\rightleftharpoons$ | $H_2(g) + 2OH^-$ | – 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 |
| $Ba^{2+} + 2e^-$ | $\rightleftharpoons$ | $Ba$ | – 2,90 |
| $K^+ + e^-$ | $\rightleftharpoons$ | $K$ | – 2,92 |
| $Li^+ + e^-$ | $\rightleftharpoons$ | $Li$ | – 3,04 |

Increasing reducing ability/*Toenemende reduserende vermoë* ↓

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

| Half-reactions/*Halfreaksies* | | | $E^{\theta}$ (V) |
|---|---|---|---|
| $Li^+ + e^-$ | $\rightleftharpoons$ | $Li$ | – 3,04 |
| $K^+ + e^-$ | $\rightleftharpoons$ | $K$ | – 2,92 |
| $Ba^{2+} + 2e^-$ | $\rightleftharpoons$ | $Ba$ | – 2,90 |
| $Ca^{2+} + 2e^-$ | $\rightleftharpoons$ | $Ca$ | – 2,87 |
| $Na^+ + e^-$ | $\rightleftharpoons$ | $Na$ | – 2,71 |
| $Mg^{2+} + 2e^-$ | $\rightleftharpoons$ | $Mg$ | – 2,37 |
| $A\ell^{3+} + 3e^-$ | $\rightleftharpoons$ | $A\ell$ | – 1,66 |
| $Mn^{2+} + 2e^-$ | $\rightleftharpoons$ | $Mn$ | – 1,18 |
| $2H_2O + 2e^-$ | $\rightleftharpoons$ | $H_2(g) + 2OH^-$ | – 0,83 |
| $Zn^{2+} + 2e^-$ | $\rightleftharpoons$ | $Zn$ | – 0,76 |
| $Cr^{2+} + 2e^-$ | $\rightleftharpoons$ | $Cr$ | – 0,74 |
| $Cr^{3+} + 3e^-$ | $\rightleftharpoons$ | $Cr$ | – 0,74 |
| $Fe^{2+} + 2e^-$ | $\rightleftharpoons$ | $Fe$ | – 0,44 |
| $Cr^{3+} + e^-$ | $\rightleftharpoons$ | $Cr^{2+}$ | – 0,41 |
| $Cd^{2+} + 2e^-$ | $\rightleftharpoons$ | $Cd$ | – 0,40 |
| $Co^{2+} + 2e^-$ | $\rightleftharpoons$ | $Co$ | – 0,28 |
| $Ni^{2+} + 2e^-$ | $\rightleftharpoons$ | $Ni$ | – 0,25 |
| $Sn^{2+} + 2e^-$ | $\rightleftharpoons$ | $Sn$ | – 0,14 |
| $Pb^{2+} + 2e^-$ | $\rightleftharpoons$ | $Pb$ | – 0,13 |
| $Fe^{3+} + 3e^-$ | $\rightleftharpoons$ | $Fe$ | – 0,04 |
| $2H^+ + 2e^-$ | $\rightleftharpoons$ | $H_2(g)$ | 0,00 |
| $S + 2H^+ + 2e^-$ | $\rightleftharpoons$ | $H_2S(g)$ | + 0,14 |
| $Sn^{4+} + 2e^-$ | $\rightleftharpoons$ | $Sn^{2+}$ | + 0,15 |
| $Cu^{2+} + e^-$ | $\rightleftharpoons$ | $Cu^+$ | + 0,16 |
| $SO_4^{2-} + 4H^+ + 4e^-$ | $\rightleftharpoons$ | $SO_2(g) + 2H_2O$ | + 0,17 |
| $Cu^{2+} + 2e^-$ | $\rightleftharpoons$ | $Cu$ | + 0,34 |
| $2H_2O + O_2 + 4e^-$ | $\rightleftharpoons$ | $4OH^-$ | + 0,40 |
| $SO_2 + 4H^+ + 2e^-$ | $\rightleftharpoons$ | $S + 2H_2O$ | + 0,45 |
| $Cu^+ + e^-$ | $\rightleftharpoons$ | $Cu$ | + 0,52 |
| $I_2 + 2e^-$ | $\rightleftharpoons$ | $2I^-$ | + 0,54 |
| $O_2(g) + 2H^+ + 2e^-$ | $\rightleftharpoons$ | $H_2O_2$ | + 0,68 |
| $Fe^{3+} + e^-$ | $\rightleftharpoons$ | $Fe^{2+}$ | + 0,77 |
| $NO_3^- + 2H^+ + e^-$ | $\rightleftharpoons$ | $NO_2(g) + H_2O$ | + 0,78 |
| $Hg^{2+} + 2e^-$ | $\rightleftharpoons$ | $Hg(\ell)$ | + 0,78 |
| $Ag^+ + e^-$ | $\rightleftharpoons$ | $Ag$ | + 0,80 |
| $NO_3^- + 4H^+ + 3e^-$ | $\rightleftharpoons$ | $NO(g) + 2H_2O$ | + 0,96 |
| $Br_2(\ell) + 2e^-$ | $\rightleftharpoons$ | $2Br^-$ | + 1,06 |
| $O_2(g) + 4H^+ + 3e^-$ | $\rightleftharpoons$ | $2H_2O$ | + 1,23 |
| $MnO_2 + 4H^+ + 2e^-$ | $\rightleftharpoons$ | $Mn^{2+} + 2H_2O$ | + 1,28 |
| $Cr_2O_7^{2-} + 14H^+ + 6e^-$ | $\rightleftharpoons$ | $2Cr^{3+} + 7H_2O$ | + 1,33 |
| $C\ell_2(g) + 2e^-$ | $\rightleftharpoons$ | $2C\ell^-$ | + 1,36 |
| $MnO_4^- + 8H^+ + 5e^-$ | $\rightleftharpoons$ | $Mn^{2+} + 4H_2O$ | + 1,52 |
| $Co^{3+} + e^-$ | $\rightleftharpoons$ | $Co^{2+}$ | + 1,82 |
| $F_2(g) + 2e^-$ | $\rightleftharpoons$ | $2F^-$ | + 2,87 |

**Increasing oxidising ability/*Toenemende oksiderende vermoë*** ↓

**Increasing reducing ability/*Toenemende reduserende vermoë*** ↑

**EXAMINATION NUMBER:**

## PHYSICAL SCIENCES P2 GRADE 12 ANSWER SHEET

### QUESTION 1

1.1 _____ (1)

1.2 _____ (1)

1.3 _____ (1)

1.4 _____ (1)

1.5 _____ (1)
**[5]**

### QUESTION 2

2.1 _____ (1)

2.2 _____ (1)

2.3 _____ (1)

2.4 _____ (1)

2.5 _____ (1)
**[5]**

### QUESTION 3

3.1 _____

_____ (2)

3.2 _____

_____ (2)

3.3 _____

_____ (2)

3.4 _____

_____ (2)

3.5 _____

_____ (2)
**[10]**

### QUESTION 4

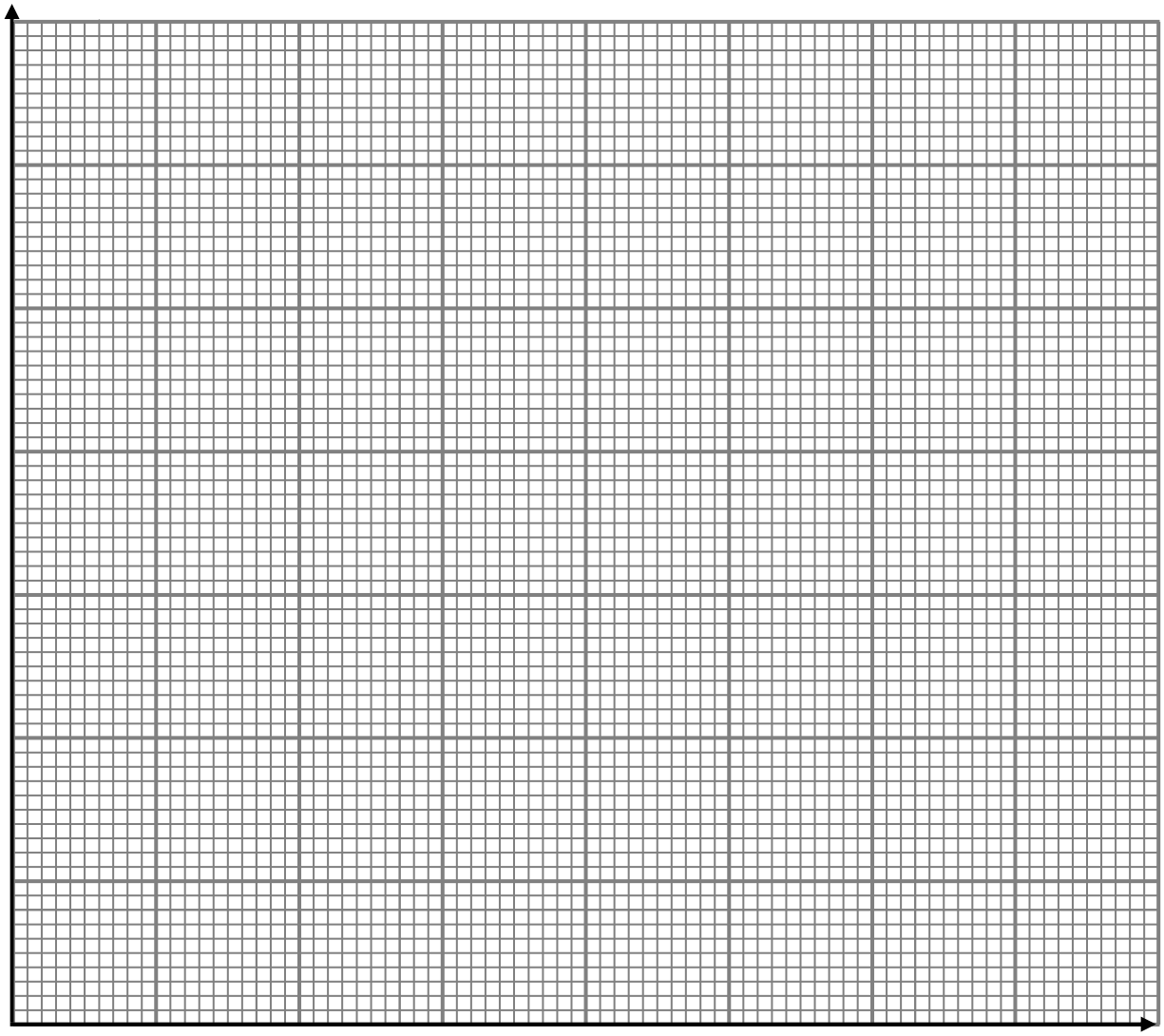
| | | | | |
|---|---|---|---|---|
| 4.1 | A | B | C | D |
| 4.2 | A | B | C | D |
| 4.3 | A | B | C | D |
| 4.4 | A | B | C | D |
| 4.5 | A | B | C | D |

**(5 x 3) [15]**

**TOTAL SECTION A*:* 35**

**EXAMINATION NUMBER:**

**QUESTION 8.5**



(6)