Province of the
EASTERN CAPE
EDUCATION

EXAMINATIONS AND ASSESSMENT CHIEF DIRECTORATE
Home of Examinations and Assessment, Zone 6, Zwelitsha, 5600
REPUBLIC OF SOUTH AFRICA, Website: www.ecdoe.gov.za

2022 NSC CHIEF MARKER'S REPORT

SUBJECT	**PHYSICAL SCIENCES**		
QUESTION PAPER	**1**	**2 X**	**3**
DURATION OF QUESTION PAPER	**3 hrs**		
PROVINCE	**EASTERN CAPE**		
DATES OF MARKING	**8-21 December 2022**		

SECTION 1: (General overview of Learner Performance in the question paper as a whole)

Rasch analysis reveals that the candidates' average score for the paper is 53 % based on

the 100 scripts sample.

The seven-point scale reveals that percentage pass for the 2022 class is 46,8% in a

population of 35 088 candidates that sat for the exam.

The population size has increased by 1,4% (34 607 learners in 2021 to 35 088 learners in 2022)

The pass rate is **4,9 % higher than 2021.**

Number of level 7s has decreased drastically (**195 in 2022** and **729 in 2020**) even though the population has increased.

The table below shows the percentage pass over a three year period (from 7 point scale)

	2020	**2021**	**2022**
Number wrote	30 467	34 607	35 088
Percentage passed	32,8%	46,8%	51,2%

The learner population size has grown in **2022 by 1,3%** compared to 2021.The pass % has improved **in 2022 to 51,2%** compared to 2021 (46,8%)

The table below shows number of level 7s and 6s over as is three year period (from 7 point scale)

	2020	**2021**	**2022**
Number of level 7s	729 (0,9%)	301 (0,9%)	**210** **(0,6%)**
Number of level 6s	534 (1,8%)	499 (1,8)	**640** **(1,8%)**

The quality of the pass has dropped i.e. fewer level 7s **(-0,3%)** and level 6s remained the same
(1,8%).

The questions that scored the highest % are:

Question 1 (Multiple Choice) with a score of 48%.

Question 8 (Galvanic Cells) with a score of 45%.

Question 3 (Physical properties of Organic Compounds) with a score of 44%.

Question 7(Acids and bases) with a score of 41%.

Poorly performed questions include:

Question 6 (Chemical Equilibrium) with a score of 20%.

Question 9 (Electrolytic cells) with a score of 23%.

Question 5 (Rate and extent of reactions) with a score of 32%.

Question 2 (Basic organic chemistry concepts) with a score of 33%

Question 4 (Organic chemistry reactions) with a score of 33%

The following sub questions were poorly answered by candidates:

1.4 Reaction rates (14%)

1.7 Acids & bases (Hydrolysis) (36%)

1.8 Acids & bases (Titration) (37%)

6.5 Chemical equilibrium (Kc calculation) (5%)

6.4 Chemical equilibrium (Le Chatelier) (15%)

6.6 Chemical equilibrium (Equilibrium graph) (16%)

9.2 Electrolytic cells (calculation) (18%)

5.4 Rate and extent of reactions (graph) (21%)

2.3 Organic chemistry (Molecular formula) (23%)

8.1 Galvanic cells (23%)

4.2 Organic chemistry (Reactions) (26%)

2.2 Organic Chemistry (IUPAC naming) (31%)

7.2 Acids & bases (calculations) (31%)

5.3 Rate and extent of reactions (calculation – volume reading) (35%)

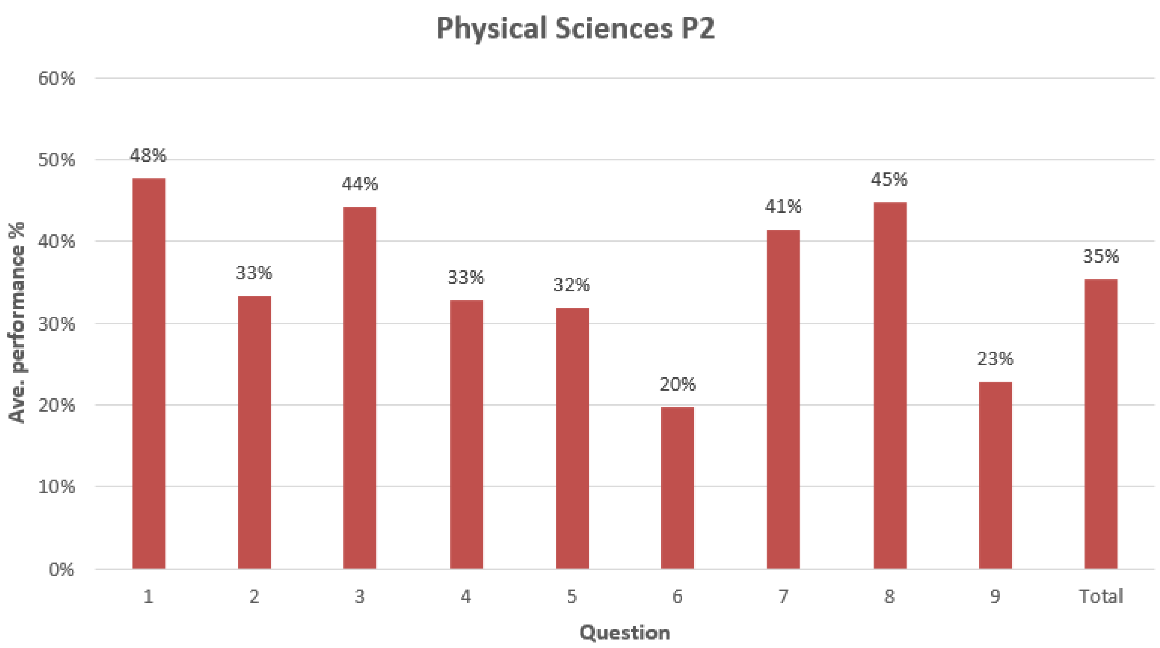
4.3 Organic chemistry (Reactions) (37%)

4.1 Organic chemistry (Tertiary halo-alkane definition) (39%)

5.1 Chemical equilibrium (Collision theory) (40%)

The table and graph below show average percent per question in 2021 NSC exam based on information from the Rasch analysis

QUESTION NUMBER	TOPICS	AVERAGE %
1	Matter and materials, Chemical change and chemical systems	48
2	Organic molecules	33
3	Organic molecules-physical properties	44
4	Organic molecules-organic reactions	33
5	Reaction rates	32
6	Chemical equilibrium	20
7	Acids and bases	41
8	Galvanic cell	45
9	Electrolytic cell	23
Total		**35%**



SECTION 2: Comment on candidates' performance in individual questions

QUESTION 1

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

- Candidates recorded a score of 48%, which is the same as in 2021.
- Candidates did well in sub-questions Q1.1 (82%), 1Q.6 (69%), Q1.9 (64%)
- Sub-questions poorly answered were Q1.4 (14%), Q1.7 (36%), Q1.8 (37%), Q1.5 (39%)

(b) Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Q 1.4

- Was the poorest answered multiple-choice question. Most common incorrect answer is D. Candidates have a misconception about the word "rate". They include "rate" and "per unit time" in the same sentence. One cannot use "per unit time" if the word "rate" is there.

Q 1.5

- Candidates did not know that volume has no effect on reaction rate.

Q 1.7

- Candidates have a poor understanding of hydrolysis. Candidates did not understand that a strong acid and a strong base would not cause hydrolysis.

Q 1.8

- Candidates did not understand "at the equivalence point of pH 7" and did not link it to a strong acid reacting with a strong base. They were therefore not able to identify the correct acid and suitable indicator.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Q1.4

- The teachers must be aware that there are 2 ways to define rate of reaction, e.g., "change in concentration of reactants or products per unit time" or 'rate of change in concentration of the products or reactants"

- Learners memorize definitions without understanding it. Educator must apply English Across the Curriculum (explaining the definition so that learners will understand it).
- Educators must guide and learners must practice the skill of eliminating incorrect answers.
- Assessing multiple choice on a regular basis in tests and include multiple choice questions in all topics, using past papers.
- Educators must teach all the content that learners are supposed to learn according to the Examination Guidelines and AT.
- Using past papers as a resource for revision to expose learners to different types of questions.
- Subject Advisors / Lead teachers / Teachers should compile a booklet of MCQ arranged according to topics for schools. These questions can be used for weekly assessments.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

- Learners must be taught not to leave multiple choice questions unanswered as there is no negative mark for an incorrect answer.

QUESTION 2

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

Q 2.1

- Candidates performed moderately at 48%.

Q 2.1.1 to 2.1.3

- Were well-answered. Candidates know that a ketone and aldehyde are functional isomers.
- The average score for question 2 was 33%. This question was poorly answered.

Q 2.2

- IUPAC naming of a halo-alkane, alkyne and an aldehyde (31%).
- Sub-questions with the lowest scores were 2.3 (23%) – esterification. Question 2.3.1 was answered well, but 2.3.2 was poorly answered. This was a higher order question.

(b) Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Q 2.1.3

- Common mistakes were CNC2N+2, C_NC_{2N+2} and C_xH_{2x+2}.

Q 2.2.1

- When writing IUPAC names, substituents are written alphabetically, that's why many learners started with bromo. Many learners wrote "3-bromo-4,4-dimethylhexane" or "methly" instead of "methyl". Some candidates used dibromine or dibromide instead of dibromo.
- Teachers and learners are misinterpreting "when naming haloalkanes, halogen substituents do not get preference over alkyl groups".
- The naming of halo-alkanes is a challenge. Incorrect sequencing of substituents and/or omission or incorrect use of commas and hyphens were often found in answers of candidates.

Q 2.2.2

- Many leaners wrote "4,4 – dimethyl-2-pentayne" OR "4,4 – dimethylpentan-2-yne".

Q 2.2.3

- Many learners wrote 1-butanal/butan-1-al.
- The learners are not following the rules for IUPAC naming.

Q 2.3.2

- It was a higher order question.
  Many learners wrote molecular formula of the ester "$C_6H_{12}O_2$" and not the carboxylic acid. OR Many learners wrote the molecular formula for compound S.
- The phrasing of the question was poor therefore candidates did not understand question.

(c) Provide suggestions for improvement in relation to Teaching and Learning

- Educators should do more examples on the different isomers and ensure that learners know that functional isomers are: ketone and aldehyde; esters and carboxylic acids.
- Rules on nomenclature should be taught and practiced regularly when teaching IUPAC naming.
- When it is an aldehyde, the numbering must NOT be used to indicate the position of the functional group since the functional group is always on C_1, e.g. it should be butanal and not 1-butanal/ butan-1-al.
- Examination Guidelines 2021 Pg 18 , Chief Markers Report and the DBE Diagnostic report should be used WITH the CAPS documents when preparing and planning for a lesson (so that educators can see the depth/extent of a specific topic).
- Develop exercises that address the IUPAC naming.
- Emphasis on the difference between molecular formulae, structural formulae and condensed structural formulae.
- Educators should apply different assessment methods, e.g., they should be able to write the structural formula and condensed formula from the IUPAC name and vice versa.
- Proper revision should be done on EMIRICAL FORMULAE and MOLECULAR FORMULAE.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

Q 2.1.3

- Common errors made in general formula for an alkyne were: CNC2N-2, C_NC_{2N-2} and C_xH_{2x-2} Some wrote Cn + H_{2n+2}

Q 2.1.4

- Many learners wrote “Hydroxide”, “Formyl”, “Carboxyl” instead of hydroxyl.
- Others wrote hydroxill, hidroxil and hidroxile.

Q 2.2.1

- Many learners wrote ‘’3-bromo-4,4-dimethylhexane’’.

Q 2.1.4

- Many learners wrote “Hydroxide”, “Formyl”, “Carboxyl”.

Q 2.2.2

- Many learners wrote “4,4 – dimethyl-2-pentayne”.

Q 2.2.3

- Many learners wrote “1-butanal” or “butan-1-al”.

Q 2.2

- Most learners got the stem of the name correct. The challenge is on separation of word and number with a hyphen, omission of di- as well as incorrect order of substituents in the name.

QUESTION 3

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

- Candidates recorded a score of 44%.
- This question was moderately answered, with learners scoring 44% 3.1 and 44% for 3.2.

(b) Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Q 3.1.2

- Candidates could not identify the controlled variable.

Q 3.1.3

- Candidates did not know the difference between bonds and intermolecular forces. They respond by saying, "more energy required to break bonds". Some refer to "bonds between atoms" instead of "intermolecular forces" or just stated that "C needs more energy" without stating what the energy is needed for. Candidates do not refer to the strength of the intermolecular forces. They just mention the type of force without referring to the strength of the intermolecular force.
- Lack of skills to interpret negative values for melting points cost many candidates marks in this question. They did not know which was the bigger value.
- Candidates did not conclude about the difference in melting point in the 2 compounds.
- "Compound D has more C atoms than compound C "which is incorrect both compounds have the same number of carbons.
- The explanation given by learners was based on boiling point instead of melting point.

Q 3.2.1

- Omission of key words in a definition cost many candidates one or two marks. Some omitted the words "pressure" or "equilibrium" or "closed system". Some candidates defined "boiling point" or "melting point".

Q 3.2.2

- Candidates forfeited one mark for mentioning "vapour" instead of "vapour pressure".
- Some candidates forfeited two marks because they failed to identify the independent variable (i.e. chain length). Some of those who identify the independent variable correctly, failed to state the correct relationship between the independent variable (chain length) and the dependent variable (vapour pressure). Eg. "the higher the vapour pressure, the longer the chain length". Some candidates wrote conclusions irrelevant for the given situation, e.g. referring to boiling point.
- Candidates use proportionality to explain the relationship between vapour pressure and chain length, i.e.vapour pressure is inversely proportional to chain length (although chain length has no numerical values).
- Candidates will forfeit the mark for "energy need to overcome forces" if strength of intermolecular forces are not previously mentioned.

Q 3.2.3

- Candidate had to identify the relationship between boiling point and vapour pressure given in the table. Then they had to identify the

alcohol, and give the IUPAC name.
- Many candidates wrote “hexanol”, “hexan-2-ol”, “hex-1-ol” (identifying the correct stem).
- Hyphens omitted.
- Some candidates wrote “pentanol”, “pent-2-ol”.

Q 3.2.4
- Temperature increase from 300K to 320K. The effect of temperature increase on the vapour pressure, to conclude if the vapour pressure would increase, decrease of remain the same. Learners had to interpret the information given.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Q 3.1.3
- Emphasise the difference between bonds between atoms in molecules (intramolecular) and forces between molecules (intermolecular) and that the strength of the intermolecular forces are responsible for the different phases. Inter-atomic or intramolecular forces which are much stronger that intermolecular forces are formed or broken during chemical reactions, when new compounds are formed. Intermolecular forces are overcome, not broken, during phase change.
- Practical skills need to be taught from grade 10 to grade 12. Learners lack skills such as identification of variables and writing of conclusions. The difference between an investigative question, hypothesis and a conclusion should be thoroughly explained.
- When writing explanations related to physical properties of compounds, learners should be taught to follow the following steps:

Comparing compounds from the same homologous series:
1. Compare the surface areas of the compounds.
2. Compare the strength of the intermolecular forces.
3. Compare the energy needed to overcome the intermolecular force.

Comparing compounds from different homologous series:
1. State the type of intermolecular force in each compound.
2. Compare the strength of the intermolecular forces.
3. Compare the energy needed to overcome the intermolecular force.

Q 3.2.1
- All definitions are stated in the Examination Guidelines and teachers must ensure that learner’s study and understand the definitions through regular testing.

Q 3.2 2
- Educators should do experiment of different factors when teaching melting point / boiling point / vapour pressure and asses the learners on the experiments.
- Assessment of experiments should include writing the different variables, hypotheses, conclusion.

Q 3.2.4
- This cohort is not familiar with the Kelvin temperature scale, as only Boyle’s Law (constant temperature) remained in the Revised ATP.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

- Use of exam guidelines as source of correct definitions for concept cannot be over-emphasised.
- There are centres that still use the phrase "break bonds" in place of "overcome intermolecular forces". This has to be brought to the attention of teachers that this leads to loss of marks. The learners learn this phrase from their teachers and use it in their explanations.
- It must be emphasized to learners that in compounds with 2 or less carbon atoms in chain, one does not need to indicate the position of the functional group except for haloalkanes.

QUESTION 4

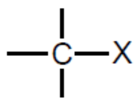
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

- Candidates recorded a score of 33%.
- Question 4.4 scored the highest at 42 % while question 4.2 showed the lowest performance at 26%.

(b) Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Q 4.1

- Common errors when giving the reasons why the compound was a tertiary halo-alkane were:
  - ➢ Referring to the halogen as a halide.
  - ➢ Referring bromine as bromide / Br / Br^-.
  - ➢ Using br (small letters) / BR (capital letters).
  - ➢ Stating that "Br is bonded to three other carbons" instead of "Br is bonded to a carbon atom which is bonded to three other carbons".
  - ➢ Misconception is that the functional group of the halo-alkanes is only -X instead of:



Q 4.2.1

- Many candidates wrote "concentrated base", "diluted base" or "strong base" instead of "concentrated strong base" or "strong base in ethanol". Candidates cannot differentiate between a strong base and a concentrated base.

Q 4.2.2

- Candidates had to move from the condensed structural formula to the molecular formula. If the reaction conditions were identified incorrectly in 4.2.1, candidates could not identify the type of reaction, resulting in them identifying the reaction as a substitution reaction instead of an elimination reaction.

Q 4.2.3

- Common errors:
  - ➢ Using molecular or condensed structural formulae instead of structural formulae when writing equations.
  - ➢ Omitting the arrow in writing chemical equations.
  - ➢ Most learners used the reaction: halo-alkane → alkene + HBr (as given in Mind the
    - o Gap / Study & Master / Solutions for all / Mind Action Series) instead of
    - o halo-alkane + KOH or NaOH or LiOH → alkene + KBr / NaBr / LiBr + H_2O (as given in Marking Guideline).
  - ➢ Incorrect functional group.
  - ➢ Carbon atom surrounded by 5 bonds.
  - ➢ Omission of bonds or omission of hydrogen atoms.
  - ➢ Double bond on carbon 1 instead of carbon 2.
- Candidates confused dehydration with dehydrohalogenation, meaning they cannot identify the type of organic reactions.
- Candidates struggled to write the structure of a major product vs a minor product, especially when it is a branched organic compound.
- Some candidates were omitting the methyl in the reactant and/or the

product or wrote $-CH_3$.

- Many candidates wrote additional reactants and/or products.

Q 4.3.1

- Common errors:
  - -OH group on the incorrect carbon atom.
  - Omission of methyl group or condensed methyl group.
  - Functional group of the alcohol condensed instead of drawing the structure.

Q 4.3.2

- Candidates could not identify the inorganic reagent.

Q 4.3.3

- Candidates could not name the addition reaction.

(c) Provide suggestions for improvement in relation to Teaching and Learning

- Learners must count the number of bonds after they draw the structural formulae.
- It is advisable for teachers to do these experiments so the learners can get use to the reaction conditions.
- Educators and learners must be made aware that the functional groups of the different homologous series are in the CAPS and Examination guidelines.
- Reaction conditions should be included in formal and informal assessment.
- Emphasise the difference between structural-, condensed structural – and molecular formulae.
- Learners need a thorough knowledge of the different prescribed Organic reactions and their conditions to analyse such diagrams. They must be prepared to analyse given data and devise steps to prepare a given compound using the reactants supplied. Subject advisors should assist teachers in compiling summaries of the different types of reactions and their conditions to enable learners to memorise the required facts.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

- Learners did not know the difference between structural formulae, condensed formulae and molecular formulae and struggled to identify the reaction conditions and the type of reactions in this question.

QUESTION 5

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

- Candidates recorded a score of 32%.
- Question 5.2 scored the highest at 47 % while question 5.4 showed the lowest performance at 21%.

(b) Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Q 5.1

- Candidates could not use the Collision theory to explain the effect of a catalyst on reaction rate. Many candidates could not even identify "catalyst" as the factor affecting reaction rate.
- Many candidates omit key words like "more"/'' effective''/''per unit time'',e.g., leaners only write ''effective collision per unit time'' or '' molecules have enough kinetic energy" or "more effective collisions".

Q 5.3.2

- Many candidates could not identify the correct formula to calculate mole.
- Many candidates wrote the molar mass of oxygen as 16g/mol.
- Many candidates substituted the volume of liquid (H_2O) in $n=V/V_m$.
- Many candidates wrote 22,4 dm^3 for V_m instead of the given 24 000 $cm^3.mol^{-1}$.
- Many candidates did not use the mole ratio.

Q 5.4.1

- Candidates could not interpret the graph.
- Many candidates cannot differentiate between "reaction is complete" and "equilibrium".

Q 5.4.3

- Candidates cannot use the rate formula to calculate mole/mass/time when given the reaction rate. Most of the candidates did not fully understand this question and gave different incorrect answers. Stoichiometry was poorly understood.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Q 5.3.2

- Before doing rate of reactions, educators should do proper revision on basic stoichiometric calculations. Educators should be aware that the formula n = V/Vm can only be used for gases.

When teaching reaction rates educators should:

- Educators should do experiments of different factors when teaching rate of reactions
  and asses the learners on the experiments.
- Assessment of experiments should include writing the different variables, hypotheses, conclusion, drawing of graphs, interpreting of graphs and different types of stoichiometric calculations.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

- Judging by learner responses there is a misconception in learners about rate of reaction and shift of equilibrium position.
- Educators should teach and assess learners on all the different type of graphs on a regular basis and how to interpret, analyse and answer questions based on graphs.
- Learners wrote "equilibrium reached". Emphasis should be placed on the difference between reversible and non-reversible reactions. Reversible reactions can reach equilibrium, while non-reversible reactions take place in one direction and cannot reach equilibrium. Furthermore, a reversible reaction can only reach equilibrium in a closed system. When written, equilibrium reactions are indicated with double arrows. Single arrows indicate non-reversible reactions.
- Ensure that learners know the different factors affecting reaction rate that should be explained in terms of the Collision theory. Use previous marking guidelines to assist learners in how to explain each factor in terms of the Collision theory.
- Subject Advisors need to support educators with stoichiometry and worksheet should be designed involving calculations. Learners have a poor understanding of stoichiometry and are very uncertain when selecting formulae for a specific calculation.

QUESTION 6

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

- Candidates recorded a score of 20%.
- Question 6.1 scored the highest at 53 % while question 6.5 showed the lowest performance at 5%.

(b) Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Q 6.4

- Candidates are confusing Le Chatelier's principle with collision theory.
- Instead of applying Le Chatelier's principle, many candidates were stating Le Chatelier's principle.
- Candidates did not know by increasing the volume, the pressure will decrease. They wrote that the ''temperature increased'' of '' concentration increased''.

Q 6.5

- It was a high order question, because very few, if any, candidates got full marks in this question.
- Many candidates did not use a table and forfeited marks because they did not include all steps in their calculations.

Q 6.6

- Most candidates could not interpret the reaction rate vs time graph.
- Candidates could not identify the specific factor influencing the equilibrium from the graph.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Q 6.1

- Educators should use the examination guidelines for definitions.
- Educators should stop using textbooks for definitions. Different textbooks have different definitions.

Q 6.2

- Educators should teach Kc calculations for homogonous and heterogonous reactions and products.

Q 6.4

- Educators should assess learners in ALL the factors effecting chemical equilibrium, not just temperature and concentration.
- When explaining answers in terms of le Chatelier's principle, the following guide will assist:

1. Mention the disturbance.
2. Describe the rule for the disturbance e.g. the disturbance in this question was an increase in temperature.
3. Mention which reaction is favored by the disturbance, eg Forward reaction or reverse reaction.

Q 6.5

- When teaching Kc, educators must use examples that calculate initial concentrations and initial moles/mass.
- Educators must start with simple problems when solving Kc calculations. Learners must be taught and allowed to practice writing Kc expressions for reactions involving gases only, gases and liquids or solids, gases and

aqueous solutions. Give learners steps to follow when calculating Kc for example:

1. Write down Kc expression.
2. Substitute values into Kc expression and solve, if possible.
3. Convert mass and concentration to moles.
4. Draw and complete a table.
5. Go back to the Kc expression.

Q 6.6

- Educators should teach and assess learners on all the different type of graphs on a regular basis.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

Q 6.1

- There are still learners using the word "stress" instead of "disturbance",e.g., " when the stress is applied on a system in equilibrium, the system will shift in such a way to overcome the stress" . The correct definition is in the examination guideline.

Q 6.2

- Many learners calculated the concentration for CS_2 using C=n/V
- Many learners used incorrect units for concentration. E.g., mol.dm^3
- Learners wrote the wrong Kc expressions, e.g., $K_c = \frac{[S]}{[CS]}$ / $K_c = \frac{[C][CS_2]}{[S]^2}$ / $K_c = \frac{[C]+[CS_2]}{[S]^2}$
- Some learners wrote Kc expressions with omissions, e.g., $K_c = \frac{[CS]}{[S]^2}$ / $K_c = \frac{[CS_2]}{[S]}$
- Some learners wrote Kw instead of Kc.
- Teachers should avoid using of $K_c = \frac{[products]}{[reactants]}$ in class. Instead, use chemical equations to teach the writing of Kc expressions.
- When using a table to solve Kc calculations, learners should be taught to use correct labels [n(initial), n(change), n(equilibrium), c(equilibrium)] in the table and write the correct values next to each label. Use previous marking guidelines to show learners the labelling in such tables.

QUESTION 7

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

- Candidates recorded a score of 41%
- Question 7.1 scored the highest at 68 % while question 7.2 showed the lowest performance at 31%, especially 7.2.3 was very poorly answered.

(b) Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Q 7.1.1

- Some candidates defined an acid in terms of Arrhenius theory.

Q 7.1.2

- Many candidates wrote "dissolved" instead of "dissociate"/" ionise", meaning there is a misconception.
- Many candidates wrote" associate" instead of "dissociate"/" ionise.

Q 7.2.2

- Many candidates wrote pH = -log [OH^-], meaning that they copy incorrectly from formula sheet.
- Candidates struggle to calculate the concentration of H_3O^+ if given the pH, because they don't know how to use the logarithm method.
- candidates cannot differentiate between OH- ions and H_3O^+ ions.

Q 7.2.3

- This was a higher order question.
- Candidates did not know they had to calculate the final mole (NaOH) and then subtract the final mole from the initial mole, to get the moles that reacted, before using the mole ratio.
- Candidates were rounding off to one decimal place.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Q 7.1.1

- Differences between Lowry-Bronsted theory and Arrhenius theory must be made clear during teaching.

Q 7.2.2

- Do exercises that will afford learners opportunity to convert between logarithmic form and exponential form.

Q 7.2.3

- Educators should do the titration experiment and do an informal assessment on titration calculations.
- Again, stoichiometric calculations are very important.
- Educators should emphasize the importance of units. There is a general rule that states, no unit no marks for final answer.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

- Subject advisors should do advocacy on using experiments as a teaching approach in this topic. Practical work to include testing pH of solutions using Universal indicator and titrations.
- Teachers need to take some time, when teaching pH, to revise the mathematical concept of converting between logarithmic form and exponential form. Logarithms are no addressed extensively in the mathematics syllabus as it was the case in the past.
- Learners should be taught to copy formulae correctly from the data sheet, especially the pH formula.
- Learners should be taught to label formulae when doing multistep calculations, eg. When calculating the number of moles of NaoH, the formula should be as follows:
- N(HCl) = cV.
- Ensure that stoichiometric calculations are properly taught in Grade 11.
- Rounding off should only be done at the final answer of the calculation. Learners should be taught not to round off in each step as it leads to an incorrect answer.

QUESTION 8

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

- Candidates recorded a score of 45%.
- Question 8.2 scored the highest at 53 % while questions 8.1 showed the lowest performance at 23%.

(b) Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Q 8.1.1

- Many candidates wrote $Zn^{2+} + 2e^{-} \rightarrow Zn$.

Q 8.1.2

- Many candidates did not know how to use the standard reduction potential table to identify the oxidising agents. E.g., Many leaners wrote that Zn is an oxidising agent
- Candidates do not understand the concept redox (reduction and oxidation).
- During the comparison, learners only wrote higher of lower by referring to the table.
- Many candidates also omitted the charge.

Q 8.2.1

- Many candidates wrote "complete the cell"/ "maintain neutrality" /" connect the 2 cells".
- There is a misconception that the salt bridge separates the anode from the cathode, and it transports electrons.
- All of these are incorrect.

Q 8.2.3

- Use of unconventional formulae $E_{cell} = E_{cat} – E_{an}$ or $E_{cell} = E_{ox} – E_{red}$ and forfeited marks for the formula.
- Many candidates did not write the unit.
- Some candidates could not identify the anode and cathode.

Q 8.2.4

- Candidates wrote capital letters, e.g., "$MN + NI^{2+} \rightarrow MN^{2+} + NI$"
- Candidates omitted the charge, e.g., "Ni^{2}"
- Some candidates wrote the cell notation.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Q 8.1.1

- Educators must use the standard reduction potential table when teaching redox reactions.
- They must show the learners where you find the oxidising and reducing agents on the table. (Left hand side of the table is the oxidising agents and right-hand side is the reducing agents)
- Educators should start in grade 11 teaching the standard reduction potential table, when teaching redox chapter.
- Educations should also use complex ions (e.g., $Cr_2O_7^{2-}$) as part of their informal assessment.
- Educators should make the data/formula sheet available to all learners before they start with a specific topic.
- Educators should conduct more informal experiments.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

- There are still schools who write formulae that are not in the formula sheet e.g., Ecell = Eox-Ered leading to loss of marks. There are schools where learners write two arrows in a half reaction-learners should always write one arrow (even if there are two arrows in a given reaction) as they will not be penalized for writing one arrow.
- Teachers need to spend time teaching learners how to use the table of reduction potentials correctly. This section is taught at the busiest of times (third term). Teachers have to find time to avoid rushing when teaching electrochemistry.
- Concepts such as reducing agent, oxidation, oxidizing agent and reduction should be taught with understanding.
- Teachers should ensure that learner's study and understand the section on the effect of a change in concentration on the cell potential in the Examination Guidelines.

QUESTION 9

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

- Candidates recorded a score of 23%.
- Question 9.1 scored the highest at 49% while question 9.2 showed the lowest performance at 18%.

(b) Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Q 9.1

- Many candidates wrote the definition of an electrolyte, "electrical energy is converted to mechanical energy" or "chemical energy is converted into electrical energy, and forfeited the marks.

Q 9.2.1

- Many candidates wrote the half reaction for chlorine.
- Candidates was expecting the decomposition of copper (II) chloride or the electrolysis of a concentrated solution of sodium chloride, e.g., $Cl_2 + 2e^- \rightarrow 2Cl^{2-}$.
- Many candidates wrote Cr (II) instead of Cr (III), e.g., $Cr^{2+} + 2e^- \rightarrow Cr$.

Q 9.2.2

- Most candidates could not integrate concepts learnt in Physics in Chemistry.

Q 9.2.3

- It was a high order question.
- Candidates cannot distinguish between different ''n's'' e.g.,
1. n for moles in $n = m/M$.
2. n for number of electrons in $n = Q/q_e$.
3. n for number of particles in $n = N/N_A$.
- Many candidates used the molar mass of chlorine instead of Cr.
- Most candidates could not integrate concepts learnt in Physics in Chemistry.
- Candidates did not use Avogadro's number or the charge on an electron and forfeited the marks.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Q 9.1

- Use definitions as they are from the Examination guidelines.

Q 9.2.3

- Educators should use graphs during their informal assessment.
- Prepare questions that involve stoichiometric calculations as well as concepts from paper 1.
- The educators should do different examples of electrolysis, electroplating, refining of metals other than those in the examination guidelines.
- Integration of paper 1 and paper 2 topics should be their informal assessment.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

Q 9.2.2

- Incorrect conversion from hours to seconds.
- Many learners wrote incorrect units, or they just left out the unit, meaning they do not know the unit.
- Learners do not write all their steps; they just give the final answer. They keep everything in the calculator.
- The trend going forward appears to be integration of concepts from Physics with Chemistry. Give learners an opportunity to do questions that integrate the two topics in Physical Sciences. For example, one can ask questions on EMF and internal resistance in a galvanic cell.
- Prepare questions on stoichiometry that involve electrochemical cells.
- When copying either the oxidation or reduction half-reaction from the Table of Standard Reduction Potentials, single arrows should be used to represent either the oxidation or reduction half-reaction.
- Teachers should provide learners with a summary of the types of prescribed electrolytic cells and thoroughly explain the functioning of each. This will enable learners to answer different questions on electrolytic cells with understanding rather than guessing.
- Teachers should prepare Grade 12 learners on how to answer questions that involve stoichiometry and should not assume that these calculations were taught in Grades 10 and 11. Learners should be made aware that stoichiometry is an integral part of Chemistry and could be assessed in any topic in the curriculum.

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY (P2)

NOVEMBER 2022

MARKS: 150

TIME: 3 hours

This question paper consists of 14 pages and 4 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your centre number and examination number in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of NINE questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between two subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. Show ALL formulae and substitutions in ALL calculations.
9. Round off your FINAL numerical answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions, etc. where required.
11. You are advised to use the attached DATA SHEETS.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 E.

1.1 Which ONE of the following terms describes hydrocarbons that contain only single bonds?

A Isomers

B Saturated

C Unsaturated

D Homologous series (2)

1.2 Which ONE of the following combinations correctly indicates the STRONGEST intermolecular forces found in ethanoic acid and methyl propanoate respectively?

	ETHANOIC ACID	METHYL PROPANOATE
A	Hydrogen bonds	Hydrogen bonds
B	Dipole-dipole forces	London forces
C	Hydrogen bonds	London forces
D	Hydrogen bonds	Dipole-dipole forces

(2)

1.3 A test tube contains a liquid hydrocarbon.

When bromine water (Br_2) is added to the test tube, the mixture decolourises IMMEDIATELY.

Which ONE of the following combinations correctly identifies the COMPOUND and the TYPE OF REACTION that takes place in the test tube?

	COMPOUND	TYPE OF REACTION
A	Hexane	Addition
B	Hexane	Substitution
C	Hex-2-ene	Addition
D	Hex-2-ene	Substitution

(2)

1.4 Which ONE of the following statements is the CORRECT definition for the rate of a reaction?

A The time taken for the reaction to take place

B The speed at which the reaction takes place

C The rate of change in concentration of the products or reactants

D The rate of change in concentration of the products or reactants per unit time (2)

1.5 Consider the balanced equation for the reaction between magnesium powder and EXCESS dilute hydrochloric acid, $HC\ell(aq)$:

$$Mg(s) + 2HC\ell(aq) \rightarrow MgC\ell_2(aq) + H_2(g)$$

Which ONE of the following will NOT increase the rate of this reaction?

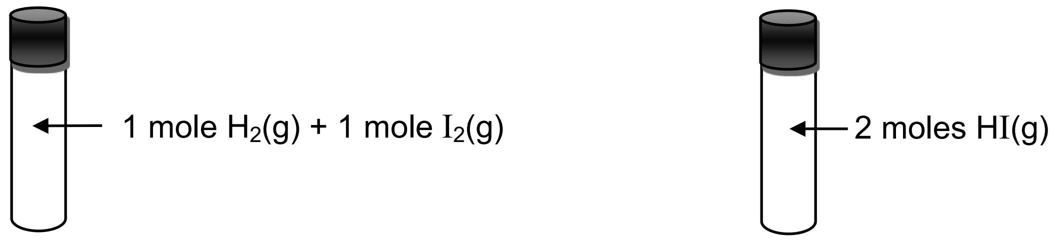
A Increasing the volume of $HC\ell(aq)$

B Increasing the temperature of $HC\ell(aq)$

C Increasing the concentration of $HC\ell(aq)$

D Adding more magnesium powder (2)

1.6 Two identical sealed gas jars, **R** and **S**, initially contain gases as shown below.



Gas jar R **Gas jar S**

Equilibrium is reached in both gas jars at 500 °C according to the following balanced equation:

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

Which ONE of the following statements is TRUE at equilibrium?

A **S** will contain 1 mole of $I_2(g)$.

B **R** will contain a larger amount of $I_2(g)$ than **S**.

C **R** and **S** will contain the same amount of $HI(g)$.

D **S** will contain a larger amount of $HI(g)$ than **R**. (2)

1.7 Which ONE of the following salts, when dissolved in water, will NOT change the pH of the water?

A Na_2CO_3

B $(COO)_2Na_2$

C $NH_4Cℓ$

D $NaCℓ$ (2)

1.8 A dilute acid is titrated against a potassium hydroxide solution, KOH(aq).

At the equivalence point the pH is 7.

Which ONE of the following combinations correctly identifies the acid and the MOST SUITABLE indicator for this titration?

	ACID	INDICATOR
A	$(COOH)_2(aq)$	Phenolphthalein
B	$(COOH)_2(aq)$	Bromothymol blue
C	HCℓ(aq)	Phenolphthalein
D	HCℓ(aq)	Bromothymol blue

(2)

1.9 Which ONE of the following statements is TRUE for an oxidising agent?

A It gains electrons.

B It causes another species in the reaction to be reduced.

C Its oxidation number does not change during a chemical reaction.

D Its oxidation number increases during a chemical reaction. (2)

1.10 Which ONE of the following metals will reduce $Cd^{2+}(aq)$ to Cd(s), but will NOT reduce $Mn^{2+}(aq)$ to Mn(s)?

A Zn

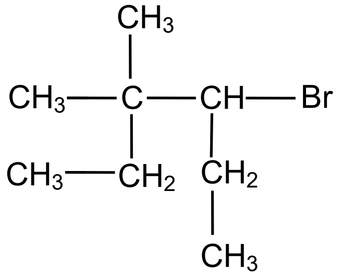
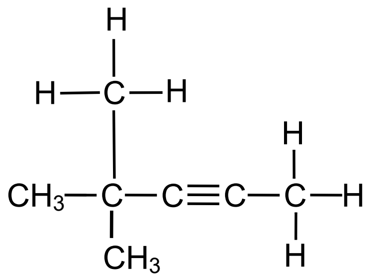
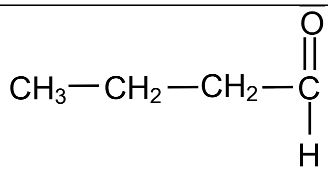
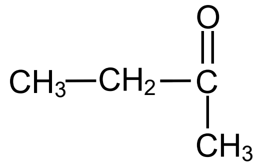
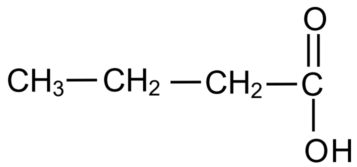
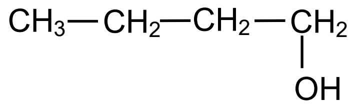
B Ag

C Ni

D Mg (2)
[20]

QUESTION 2 (Start on a new page.)

A to **F** in the table below represent six organic compounds.

A		**B**	
C		**D**	
E		**F**	

2.1 Write down the:

2.1.1 Letters that represent TWO organic compounds that are isomers of each other (1)

2.1.2 Type of isomers (CHAIN, FUNCTIONAL or POSITIONAL) identified in QUESTION 2.1.1 (1)

2.1.3 GENERAL FORMULA of the homologous series to which compound **B** belongs (1)

2.1.4 NAME of the functional group of compound **F** (1)

2.2 Write down the IUPAC name of:

2.2.1 Compound **A** (3)

2.2.2 Compound **B** (2)

2.2.3 Compound **C** (2)

2.3 Compound **F** reacts with a carboxylic acid to form compound **S** in the presence of a strong acid.

2.3.1 Write down the type of reaction that takes place. (1)

Compound **S** has an EMPIRICAL FORMULA of C_3H_6O and a molecular mass of 116 $g{\cdot}mol^{-1}$.

2.3.2 Write down the MOLECULAR FORMULA of the carboxylic acid. (3)

[15]

QUESTION 3 (Start on a new page.)

3.1 The melting points of some organic compounds are given in the table below.

COMPOUND	IUPAC NAME	MELTING POINTS (°C)
A	Propanone	-95,4
B	Butanone	-86,9
C	Pentan-2-one	-77,8
D	3-methylbutanone	-92

3.1.1 To which homologous series do the above compounds belong? (1)

The melting points of compounds **A**, **B** and **C** are compared.

3.1.2 Write down the controlled variable for this comparison. (1)

The melting points of compounds **C** and **D** are compared.

3.1.3 Fully explain the difference in the melting points of these two compounds. (4)

3.2 The table below shows the results obtained from an experiment to determine the vapour pressure of different STRAIGHT CHAIN primary alcohols at 300 K.

ALCOHOL	VAPOUR PRESSURE (kPa)
CH_3OH	16,8
C_2H_5OH	7,88
C_3H_7OH	2,8
C_4H_9OH	0,91
$C_5H_{11}OH$	0,88
$C_6H_{13}OH$	0,124

3.2.1 Define the term *vapour pressure*. (2)

3.2.2 Write down a suitable conclusion for this investigation. (2)

3.2.3 Write down the IUPAC name of the alcohol with the HIGHEST boiling point. (3)

3.2.4 The experiment is now repeated at 320 K.

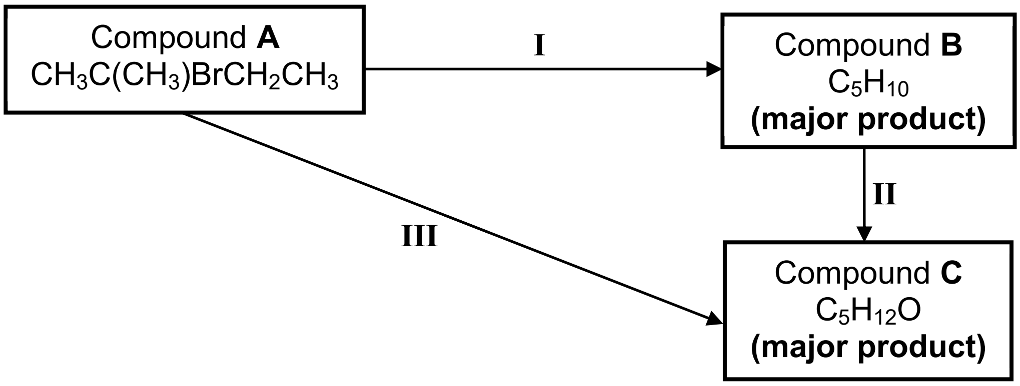
Will the vapour pressure of each compound INCREASE, DECREASE or REMAIN THE SAME? (1)

[14]

QUESTION 4 (Start on a new page.)

The flow diagram below shows how compound **A** can be used as a starting reactant to prepare two different compounds.

I, **II** and **III** represent three organic reactions.



4.1 Is compound **A** a PRIMARY, SECONDARY or TERTIARY haloalkane? Give a reason for the answer. (2)

4.2 Consider reaction **I**.

4.2.1 Besides heat, write down the other reaction condition needed. (1)

4.2.2 Write down the type of reaction that takes place. (1)

4.2.3 Using STRUCTURAL FORMULAE for the organic compounds, write down a balanced equation for the reaction. (5)

4.3 Consider reaction **II**.

Write down the:

4.3.1 STRUCTURAL FORMULA of compound **C** (2)

4.3.2 NAME or FORMULA of the inorganic reagent needed (1)

4.3.3 Type of addition reaction that takes place (1)

4.4 Consider reaction **III**.

4.4.1 Write down of the type of reaction that takes place. (1)

4.4.2 Besides heat, write down the other reaction condition needed. (1)
[15]

QUESTION 5 (Start on a new page.)

Three experiments, **A**, **B** and **C**, are carried out to investigate some of the factors that affect the rate of decomposition of hydrogen peroxide, $H_2O_2(\ell)$.

The balanced equation for the reaction is:

$$2H_2O_2(\ell) \rightarrow 2H_2O(\ell) + O_2(g)$$

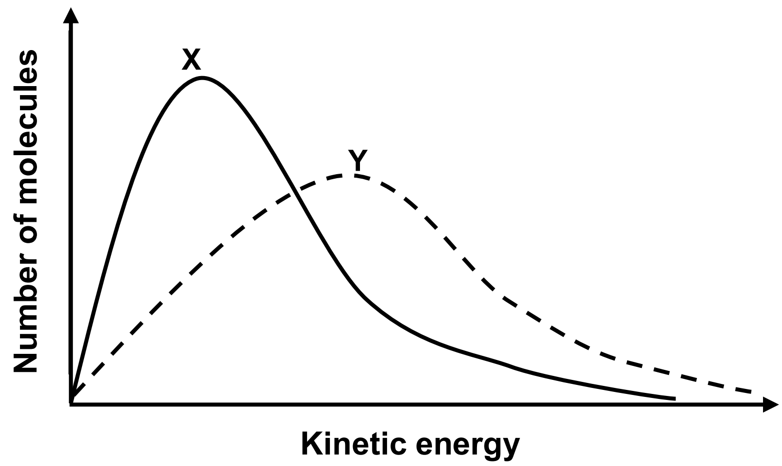
Identical samples of hydrogen peroxide are used in each experiment.

The conditions used in each experiment are summarised in the table below.

EXPERIMENT	TEMPERATURE (°C)	
A	25	Without catalyst
B	25	With catalyst
C	35	Without catalyst

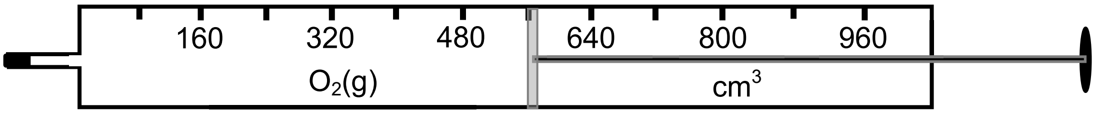
5.1 In which experiment, **A** or **B**, is the reaction rate higher? Use the collision theory to explain the answer. (4)

5.2 The Maxwell-Boltzmann distribution curves, **X** and **Y**, for two of the above experiments are shown below.



Identify the curve (**X** or **Y**) that represents experiment **C**. (2)

5.3 The volume of oxygen gas, $O_2(g)$, produced in experiment **B** during the first 3,6 s is collected in a syringe, as shown below.



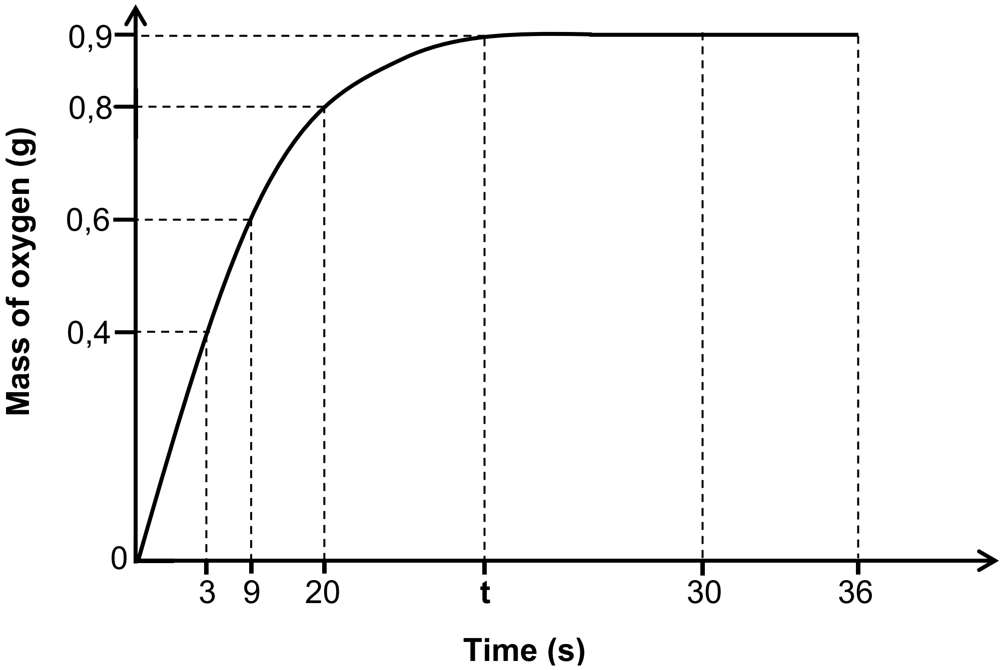
5.3.1 Write down the volume of $O_2(g)$ collected in the syringe. (2)

The balanced equation for the reaction is:

$$2H_2O_2(\ell) \rightarrow 2H_2O(\ell) + O_2(g)$$

5.3.2 Calculate the mass of water, $H_2O(\ell)$, that was produced during the first 3,6 s. Take the molar gas volume to be 24 000 $cm^3 \cdot mol^{-1}$ at 25 °C. (4)

5.4 The graph below, NOT drawn to scale, is obtained for the mass of oxygen gas produced over a period of time in experiment **A**.



Use the information in the graph to answer the following questions:

5.4.1 Write down the rate of production of oxygen gas for the interval 30 s to 36 s. (1)

5.4.2 Will the rate of the reaction in the interval 3 s to 9 s be GREATER THAN, SMALLER THAN or EQUAL TO the rate of the reaction in the interval 9 s to 20 s? (1)

5.4.3 The average rate of decomposition of hydrogen peroxide is $2,1 \times 10^{-3}$ $mol \cdot s^{-1}$.

Calculate the value of time **t** on the graph. (5)

[19]

QUESTION 6 (Start on a new page.)

Carbon, C(s), reacts with sulphur, S(g), according to the following balanced equation:

$$C(s) + 2S(g) \rightleftharpoons CS_2(g) \qquad \Delta H > 0$$

The system reaches equilibrium at temperature T in a sealed 2 dm^3 container.

The K_c value is 9,4 at temperature T.

6.1 State Le Chatelier's principle. (2)

At equilibrium, 1 mole of carbon disulphide, $CS_2(g)$, is present in the container.

6.2 Calculate the concentration of S(g) present at equilibrium. (4)

The volume of the container is now DOUBLED at temperature T. After a while, a NEW equilibrium is established.

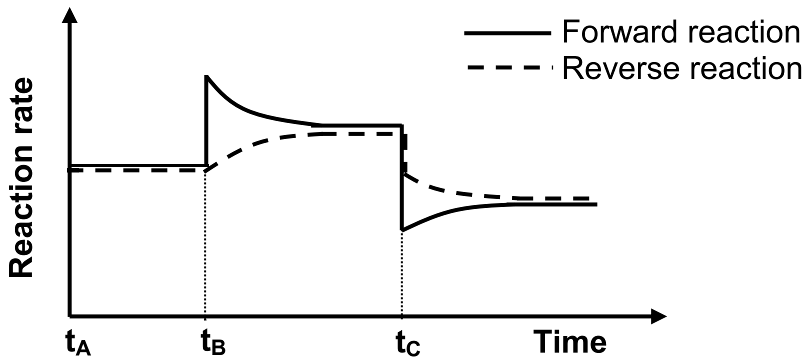
6.3 How will the amount of S(g) change as this new equilibrium is established? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

6.4 Explain the answer to QUESTION 6.3 in terms of Le Chatelier's principle. (3)

6.5 If the concentration of $CS_2(g)$ CHANGES by **x** $mol{\cdot}dm^{-3}$, write down an expression for the equilibrium constant, K_c, in terms of **x**.

Show ALL your workings. NO simplification or solving for **x** is required. (5)

6.6 The reaction rate-time graph below represents further changes made to the equilibrium mixture. The volume of the container is kept constant.



6.6.1 What do the parallel lines between $\mathbf{t_A}$ and $\mathbf{t_B}$ represent? (1)

6.6.2 What change was made to the equilibrium mixture at $\mathbf{t_B}$? (1)

6.6.3 Give a reason for the sudden change in the reaction rate at $\mathbf{t_C}$. (1)

6.6.4 Fully explain the answer to QUESTION 6.6.3. (3)
[21]

QUESTION 7 (Start on a new page.)

7.1 Ethanoic acid is a weak acid that reacts with water according to the following balanced equation:

$$CH_3COOH(aq) + H_2O(\ell) \rightleftharpoons CH_3COO^-(aq) + H_3O^+(aq)$$

7.1.1 Define an *acid* in terms of the Lowry-Brønsted theory. (2)

7.1.2 Give a reason why ethanoic acid is classified as a WEAK acid. (1)

7.1.3 Write down the formulae of the TWO bases in the equation above. (2)

7.2 A flask contains 300 cm^3 of dilute sodium hydroxide, NaOH(aq), of concentration 0,167 $mol\cdot dm^{-3}$.

7.2.1 Calculate the number of moles of sodium hydroxide in the flask. (3)

Ethanoic acid of volume 500 cm^3 and of unknown concentration, **X**, is now added to this flask to give a solution of volume 800 cm^3.

It is found that the pH of the mixture is 11,4.

The balanced equation for the reaction is:

$$NaOH(aq) + CH_3COOH(aq) \rightarrow CH_3COONa(aq) + H_2O(\ell)$$

Calculate the:

7.2.2 Concentration of the $OH^-(aq)$ in the mixture (4)

7.2.3 Initial concentration, **X**, of the ethanoic acid solution (6)
[18]

QUESTION 8 (Start on a new page.)

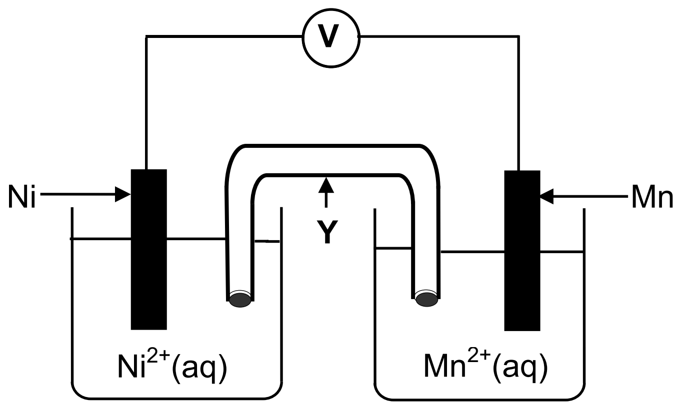
8.1 A piece of zinc (Zn) is placed in a test tube containing an acidified permanganate solution, $MnO_4^-(aq)$. After some time, it is found that a redox reaction has taken place.

Use the Table of Standard Reduction Potentials to answer the following questions:

8.1.1 Write down the NAME or FORMULA of the reducing agent. (1)

8.1.2 Refer to the relative strengths of the OXIDISING AGENTS to explain why a redox reaction has taken place. (3)

8.2 A standard electrochemical cell is set up as shown below.



8.2.1 Write down the function of component **Y**. (1)

8.2.2 In which direction will electrons flow in the external circuit? Choose from 'Ni to Mn' OR 'Mn to Ni'. (2)

8.2.3 Calculate the initial emf of this cell. (4)

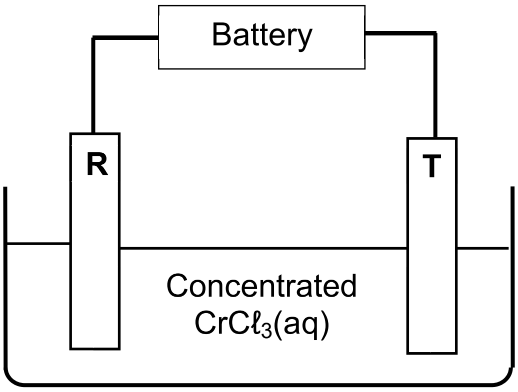
8.2.4 Write down the balanced equation for the net cell reaction taking place. (3)

8.2.5 The concentration of $Ni^{2+}(aq)$ is now increased.

Will the reading on the voltmeter INCREASE, DECREASE or REMAIN THE SAME? (1)
[15]

QUESTION 9 (Start on a new page.)

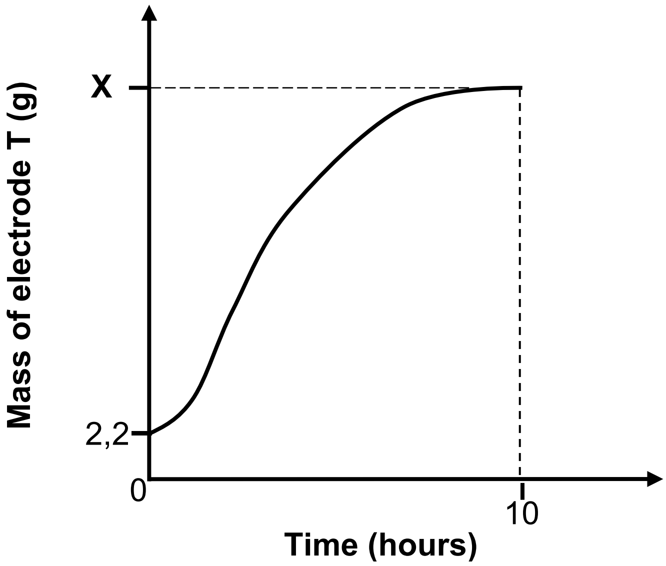
The diagram below represents a simplified cell used for the electrolysis of CONCENTRATED chromium(III) chloride, $CrCl_3(aq)$. Electrodes **R** and **T** are made of carbon.



The net cell reaction is: $2CrCl_3(aq) \rightarrow 2Cr(s) + 3Cl_2(g)$

9.1 Define the term *electrolysis*. (2)

9.2 The graph below, NOT drawn to scale, represents the changes in the mass of electrode **T** during electrolysis.



9.2.1 Write down the half-reaction that takes place at electrode **T**. (2)

A current of 2,5 A passes through the cell for 10 hours.

Calculate the:

9.2.2 Total charge that flows through the cell during this time (3)

9.2.3 Value of **X** as shown on the graph (6)
[13]

TOTAL: 150

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 *Standaarddruk*	p^{θ}	$1{,}013 \times 10^{5}$ Pa
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	$22{,}4\ dm^3{\cdot}mol^{-1}$
Standard temperature *Standaardtemperatuur*	T^{θ}	273 K
Charge on electron *Lading op elektron*	e	$-1{,}6 \times 10^{-19}$ C
Avogadro's constant *Avogadro-konstante*	N_A	$6{,}02 \times 10^{23}\ mol^{-1}$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or/*of* $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at/*by* 298 K	
$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode} / E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$ or/*of* $E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation} / E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$ or/*of* $E^{\theta}_{cell} = E^{\theta}_{oxidising agent} - E^{\theta}_{reducing agent} / E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$	
$q = I\Delta t$ $n = \frac{Q}{e}$ or/*of* $n = \frac{Q}{q_e}$	

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

KEY/*SLEUTEL*

Atomic number / *Atoomgetal*	Electronegativity / *Elektronegatiwiteit*	Symbol / *Simbool*	Approximate relative atomic mass / *Benaderde relatiewe atoommassa*
29	1,9	Cu	63,5

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

TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARD-REDUKSIEPOTENSIALE

Increasing strength of oxidising agents/*Toenemende sterkte van oksideermiddels* ↑

Increasing strength of reducing agents/*Toenemende sterkte van reduseermiddels* ↓

Half-reactions/*Halfreaksies*			**E^θ (V)**
$F_2(g) + 2e^-$	$\rightleftharpoons$	$2F^-$	+ 2,87
$Co^{3+} + e^-$	$\rightleftharpoons$	Co^{2+}	+ 1,81
$H_2O_2 + 2H^+ + 2e^-$	$\rightleftharpoons$	$2H_2O$	+1,77
$MnO_4^- + 8H^+ + 5e^-$	$\rightleftharpoons$	$Mn^{2+} + 4H_2O$	+ 1,51
$C\ell_2(g) + 2e^-$	$\rightleftharpoons$	$2C\ell^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	$\rightleftharpoons$	$2Cr^{3+} + 7H_2O$	+ 1,33
$O_2(g) + 4H^+ + 4e^-$	$\rightleftharpoons$	$2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^-$	$\rightleftharpoons$	$Mn^{2+} + 2H_2O$	+ 1,23
$Pt^{2+} + 2e^-$	$\rightleftharpoons$	Pt	+ 1,20
$Br_2(\ell) + 2e^-$	$\rightleftharpoons$	$2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^-$	$\rightleftharpoons$	$NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^-$	$\rightleftharpoons$	$Hg(\ell)$	+ 0,85
$Ag^+ + e^-$	$\rightleftharpoons$	Ag	+ 0,80
$NO_3^- + 2H^+ + e^-$	$\rightleftharpoons$	$NO_2(g) + H_2O$	+ 0,80
$Fe^{3+} + e^-$	$\rightleftharpoons$	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
$SO_2 + 4H^+ + 4e^-$	$\rightleftharpoons$	$S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^-$	$\rightleftharpoons$	$4OH^-$	+ 0,40
$Cu^{2+} + 2e^-$	$\rightleftharpoons$	Cu	+ 0,34
$SO_4^{2-} + 4H^+ + 2e^-$	$\rightleftharpoons$	$SO_2(g) + 2H_2O$	+ 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
$\mathbf{2H^+ + 2e^-}$	$\rightleftharpoons$	$\mathbf{H_2(g)}$	**0,00**
$Fe^{3+} + 3e^-$	$\rightleftharpoons$	Fe	− 0,06
$Pb^{2+} + 2e^-$	$\rightleftharpoons$	Pb	− 0,13
$Sn^{2+} + 2e^-$	$\rightleftharpoons$	Sn	− 0,14
$Ni^{2+} + 2e^-$	$\rightleftharpoons$	Ni	− 0,27
$Co^{2+} + 2e^-$	$\rightleftharpoons$	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
$Zn^{2+} + 2e^-$	$\rightleftharpoons$	Zn	− 0,76
$2H_2O + 2e^-$	$\rightleftharpoons$	$H_2(g) + 2OH^-$	− 0,83
$Cr^{2+} + 2e^-$	$\rightleftharpoons$	Cr	− 0,91
$Mn^{2+} + 2e^-$	$\rightleftharpoons$	Mn	− 1,18
$A\ell^{3+} + 3e^-$	$\rightleftharpoons$	$A\ell$	− 1,66
$Mg^{2+} + 2e^-$	$\rightleftharpoons$	Mg	− 2,36
$Na^+ + e^-$	$\rightleftharpoons$	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

Increasing strength of oxidising agents/*Toenemende sterkte van oksideermiddels* ↓

Increasing strength of reducing agents/*Toenemende sterkte van reduseermiddels* ↑

Half-reactions/*Halfreaksies*			E^θ (V)
$Li^+ + e^-$	⇌	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	− 2,36
$A\ell^{3+} + 3e^-$	⇌	$A\ell$	− 1,66
$Mn^{2+} + 2e^-$	⇌	Mn	− 1,18
$Cr^{2+} + 2e^-$	⇌	Cr	− 0,91
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	− 0,83
$Zn^{2+} + 2e^-$	⇌	Zn	− 0,76
$Cr^{3+} + 3e^-$	⇌	Cr	− 0,74
$Fe^{2+} + 2e^-$	⇌	Fe	− 0,44
$Cr^{3+} + e^-$	⇌	Cr^{2+}	− 0,41
$Cd^{2+} + 2e^-$	⇌	Cd	− 0,40
$Co^{2+} + 2e^-$	⇌	Co	− 0,28
$Ni^{2+} + 2e^-$	⇌	Ni	− 0,27
$Sn^{2+} + 2e^-$	⇌	Sn	− 0,14
$Pb^{2+} + 2e^-$	⇌	Pb	− 0,13
$Fe^{3+} + 3e^-$	⇌	Fe	− 0,06
$2H^+ + 2e^-$	**⇌**	**$H_2(g)$**	**0,00**
$S + 2H^+ + 2e^-$	⇌	$H_2S(g)$	+ 0,14
$Sn^{4+} + 2e^-$	⇌	Sn^{2+}	+ 0,15
$Cu^{2+} + e^-$	⇌	Cu^+	+ 0,16
$SO_4^{2-} + 4H^+ + 2e^-$	⇌	$SO_2(g) + 2H_2O$	+ 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
$Cu^+ + e^-$	⇌	Cu	+ 0,52
$I_2 + 2e^-$	⇌	$2I^-$	+ 0,54
$O_2(g) + 2H^+ + 2e^-$	⇌	H_2O_2	+ 0,68
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+ 0,77
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+ 0,80
$Ag^+ + e^-$	⇌	Ag	+ 0,80
$Hg^{2+} + 2e^-$	⇌	$Hg(\ell)$	+ 0,85
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Br_2(\ell) + 2e^-$	⇌	$2Br^-$	+ 1,07
$Pt^{2+} + 2e^-$	⇌	Pt	+ 1,20
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+ 1,23
$O_2(g) + 4H^+ + 4e^-$	⇌	$2H_2O$	+ 1,23
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 1,33
$C\ell_2(g) + 2e^-$	⇌	$2C\ell^-$	+ 1,36
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+ 1,51
$H_2O_2 + 2H^+ + 2e^-$	⇌	$2H_2O$	+1,77
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81
$F_2(g) + 2e^-$	⇌	$2F^-$	+ 2,87

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

PHYSICAL SCIENCES: CHEMISTRY (P2)
FISIESE WETENSKAPPE: CHEMIE (V2)

NOVEMBER 2022

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

DBE CE — 28/11/22

DBE IMs — 28/11/22

Approved: Umalusi Moderators — 28/11/22

These marking guidelines consist of 19 pages.
Hierdie nasienriglyne bestaan uit 19 bladsye.

DEPARTMENT OF BASIC EDUCATION
PRIVATE BAG X895, PRETORIA 0001
2022 -11- 28
APPROVED MARKING GUIDELINE
PUBLIC EXAMINATION

QUESTION 1/*VRAAG 1*

1.1	B ✓✓	(2)
1.2	D ✓✓	(2)
1.3	C ✓✓	(2)
1.4	C ✓✓	(2)
1.5	A ✓✓	(2)
1.6	C ✓✓	(2)
1.7	D ✓✓	(2)
1.8	D ✓✓	(2)
1.9	A ✓✓	(2)
1.10	A ✓✓	(2) **[20]**

QUESTION 2/*VRAAG 2*

2.1

2.1.1 C & D ✓ (1)

2.1.2 Functional/*Funksionele* ✓ (1)

2.1.3 C_nH_{2n-2} ✓ (1)

2.1.4 Hydroxyl (group)/*Hidroksiel(groep)* ✓ (1)

2.2

2.2.1 4-bromo-3,3-dimethylhexane/*4-bromo-3,3-dimetielheksaan* ✓✓✓

Marking criteria:
- Correct stem i.e. hexane. ✓
- All substituents (bromo and dimethyl) correctly identified. ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓

Nasienkriteria:
- *Korrekte stam d.i. heksaan.* ✓
- *Alle substituente (bromo en dimetiel) korrek geïdentifiseer.* ✓
- *IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas.* ✓

(3)

2.2.2 4,4-dimethylpent-2-yne/4,4-dimethyl-2-pentyne ✓✓
4,4-dimetielpent-2-yn/4,4-dimetiel-2-pentyn

Marking criteria/*Nasienkriteria:*
- Correct stem and substituents: dimethyl and pentyne ✓
  Korrekte stam en substituente: dimetiel en pentyn
- IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓
  IUPAC-naam heeltemal korrek insluitende nommering, volgorde, koppeltekens en kommas.

(2)

2.2.3 Butanal/*Butanaal* ✓✓

Marking criteria/*Nasienkriteria*:
- Correct functional group: -al / *Korrekte funksionele groep: –aal* ✓
- IUPAC name correct/*IUPAC-naam korrek* ✓

(2)

2.3

2.3.1 Esterification/condensation ✓
Esterfikasie/verestering/kondensasie (1)

2.3.2 $M(C_3H_6O) = 58\ g{\cdot}mol^{-1}$

$$\frac{\text{molecular mass of molecular formula}}{\text{molecular mass empirical formula}}$$

$$= \frac{116}{58} = 2$$

Compound S = $C_6H_{12}O_2$ ✓
$C_2H_4O_2$ ✓✓

Marking criteria/*Nasienkriteria*:
- $C_6H_{12}O_2$ ✓
- $C_2H_4O_2$ ✓✓
- If only correct answer given ✓✓✓
  Indien slegs korrekte antwoord gegee

NOTE/*LET WEL*
- Condensed or structural formula/*Gekondenseerde of struktuurformule*: Max./*Maks.* $^2/_3$

(3)
[15]

DEPARTMENT OF BASIC EDUCATION
PRIVATE BAG X895, PRETORIA 0001
2022 -11- 28
APPROVED MARKING GUIDELINE
PUBLIC EXAMINATION

QUESTION 3/*VRAAG 3*

3.1.1 Ketone/*Ketoon* ✓ (1)

3.1.2 Functional group/homologous series ✓
Funksionele groep/homoloë reeks (1)

3.1.3

Marking criteria: • Compare structures. ✓ • Compare the strength of intermolecular forces. ✓ • Compare the energy required to overcome intermolecular forces. ✓ • State the difference in melting point. ✓ ***Nasienkriteria:*** • *Vergelyk strukture.* ✓ • *Vergelyk die sterkte van intermolekulêre kragte.* ✓ • *Vergelyk die energie benodig om intermolekulêre kragte te oorkom.* ✓ • *Noem die verskil in smeltpunte.* ✓

Pentan-2-one/C

- **Structure:**
  Longer chain length/less branched/less compact/less spherical/larger surface area (over which intermolecular forces act). ✓
- **Intermolecular forces:**
  Stronger/more intermolecular forces/Van der Waals forces/*London forces/* dipole-dipole forces. ✓
- **Energy:**
  More energy needed to overcome or break intermolecular forces/Van der Waals forces/dipole-dipole forces. ✓
- Higher melting point. ✓

NOTE
IF higher boiling point - Max. $^3/_4$

OR

3-methylbutanone/D

- **Structure:**
  Shorter chain length/more branched/more compact more spherical/smaller surface area (over which intermolecular forces act). ✓
- **Intermolecular forces:**
  Weaker/less intermolecular forces/Van der Waals forces/*London forces/* dipole-dipole forces. ✓
- **Energy:**
  Less energy needed to overcome or break intermolecular forces/Van der Waals force/dipole-dipole forces. ✓
- Lower melting point. ✓

NOTE
IF lower boiling point - Max. $^3/_4$

Pentan-2-oon/C

- ***Struktuur*:**
  Langer kettinglengte/minder vertak/minder kompak/minder sferies/groter oppervlak (waaroor intermolekulêre kragte werk). ✓
- ***Intermolekulêre kragte*:**
  Sterker/meer intermolekulêre kragte/Van der Waalskragte/Londonkragte/ dipool-dipoolkragte. ✓
- *Meer energie benodig om intermolekulêre kragte/Van der Waalskragte/ Londonkragte/dipool-dipoolkragte te oorkom/breek.* ✓
- *Hoër smeltpunt.* ✓

LET WEL
***INDIEN** hoër kookpunt - Maks.* $^3/_4$

OF

3-metielbutanoon/D

- ***Struktuur*:**
  Korter kettinglengte/meer vertak/meer kompak/meer sferies/kleiner oppervlak (waaroor intermolekulêre kragte werk). ✓
- ***Intermolekulêre kragte*:**
  Swakker/minder intermolekulêre kragte/Van der Waalskragte/ Londonkragte/dipool-dipoolkragte. ✓
- ***Energie*:**
  Minder energie benodig om intermolekulêre kragte/Van der Waalskragte/ Londonkragte/dipool-dipoolkragte te oorkom/breek. ✓
- *Laer smeltpunt.* ✓

LET WEL
***INDIEN** laer kookpunt - Maks.* $^3/_4$ (4)

3.2.1

Marking criteria/*Nasienkriteria*
If any one of the underlined key words phrases in the **correct context** (vapour pressure) is omitted, deduct 1 mark./*Indien enige van die onderstreepte sleutelwoorde of frases in die* ***korrekte konteks*** *(dampdruk) uitgelaat is, trek 1 punt af.*

The pressure exerted by a vapour at equilibrium with its liquid in a closed system. ✓✓
Die druk uitgeoefen deur 'n damp in ewewig met sy vloeistof in 'n geslote sisteem. (2)

3.2.2

Marking criteria/*Nasienkriteria:*
• Dependent and independent variables correctly identified. ✓ *Afhanklike en onafhanklike veranderlikes korrek geïdentifiseer.*
• Correct relationship between dependent and independent variables stated. ✓ *Korrekte verwantskap tussen die afhanklike en onafhanklike veranderlikes gestel.*

Vapour pressure decreases with increase in number of C atoms/chain length. ✓✓
Dampdruk neem af met toename in aantal C-atome/kettinglengte.
OR/*OF*
Vapour pressure increases with decrease in number of C atoms/chain length.
Dampdruk neem toe met afname in aantal C-atome/kettinglengte. (2)

3.2.3 Hexan-1-ol/1-Hexanol ✓✓✓
Heksan-1-ol/1-Heksanol

Marking criteria/*Nasienkriteria*
- Correct chain length i.e. hex ✓
  Korrekte kettinglengte d.i. heks
- **IF** hexanol/***INDIEN*** *heksanol*
  Max/*Maks*: $^2/_3$
- Whole name correct./*Volledige naam korrek.* $^3/_3$

(3)

3.2.4 Increases/*Toeneem* ✓ (1)
[14]

QUESTION 4/*VRAAG 4*

4.1 Tertiary/*Tersiêre* ✓

The halogen/bromine/functional group (-X) is bonded to a C atom that is bonded to three other C atoms/ a tertiary C atom. ✓
Die halogeen/broom/funksionele groep (-X) is gebind aan 'n C-atoom wat aan drie ander C-atome gebind is/ 'n tersiêre C-atoom.

OR/*OF*
The functional group (— C —) is bonded to three other C atoms.
X/Br

Die funksionele groep (— C —) is gebind aan drie ander C-atome.
X/Br

(2)

4.2.1 Concentrated strong base ✓
OR
Concentrated NaOH/KOH/LiOH/sodium hydroxide/ potassium hydroxide/ lithium hydroxide
OR
Strong base/NaOH/KOH/LiOH/sodium hydroxide/ potassium hydroxide/lithium hydroxide in ethanol.

Gekonsentreerde sterk basis
OF
Gekonsentreerde NaOH /KOH/ LiOH /natriumhidroksied/ kaliumhidroksied/ litiumhidroksied
OF
Sterk basis/NaOH /KOH/ LiOH / natriumhidroksied/kaliumhidroksied/litium-hidroksied in etanol (1)

4.2.2 Elimination/dehydrohalogenation/dehydrobromination ✓
Eliminasie/dehidrohalogenering/dehidrohalogenasie/dehidrobrominasie/ dehidrobromonering (1)

4.2.3

Marking criteria:

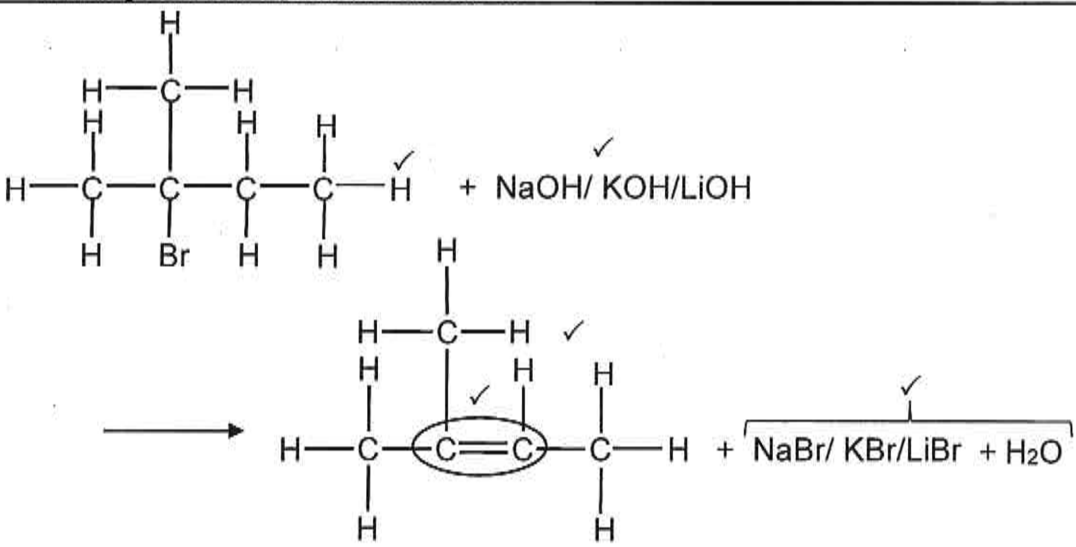
- Whole structural formula correct for compound A. ✓
- React (2-bromo-2-methylbutane) with NaOH/KOH/LiOH. ✓
- Functional group of alkene correct. ✓
- Whole structural formula of alkene correct. ✓
- NaBr/KBr/LiBr + H_2O ✓

Nasienkriteria:

- *Hele struktuurformule vir verbinding A korrek.* ✓
- *Reageer (2-bromo-2-metielbutaan) met NaOH/KOH/LiOH.* ✓
- *Funksionele groep van alkeen korrek.* ✓
- *Hele struktuurformule van alkeen korrek.* ✓
- *NaBr/KBr/LiBr + H_2O* ✓

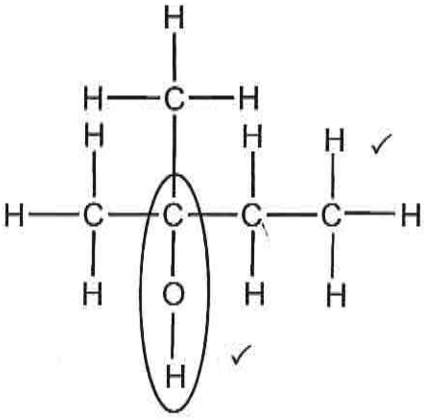
IF/*INDIEN*

- Any error e.g. omission of H atoms, condensed or semi structural formula/*Enige fout bv. weglating van H-atome, gekondenseerde of semi-struktuurformule:* Max/*Maks.* $^3/_5$
- Any additional reactants or products /*Enige addisionele reaktanse of produkte:* Max./*Maks.* $^4/_5$
- Molecular formulae used:/*Molekulêre formule gebruik:* Max./*Maks.* $^2/_5$
- No or incorrect inorganic reactants or products:/ *Geen of verkeerde anorganiese reaktanse of produkte:* Max./*Maks.* $^3/_5$
- Marking rule 6.3.10/*Nasienreël 6.3.10*



(5)

4.3.1



Marking criteria/*Nasienkriteria*:

- Functional group correct ✓
  Funksionele groep korrek
- Whole structure correct ✓
  Hele struktuur korrek

(2)

4.3.2 Water/H_2O ✓ (1)

4.3.3 Hydration/*Hidrasie* ✓ (1)

4.4.1 Substitution/Hydrolysis/*Substitusie/Hidrolise* ✓ (1)

4.4.2 Dilute strong base ✓
OR: Dilute NaOH/KOH/LiOH/sodium hydroxide/potassium hydroxide/lithium hydroxide
OR: NaOH(aq)/KOH(aq)/LiOH(aq)
OR: (Add) water/H_2O

Verdunde sterk basis
OF: *Verdunde NaOH/KOH/LiOH/natriumhidroksied/ kaliumhidroksied/ litiumhidroksied*
OF**:** *NaOH(aq)/KOH(aq)/LiOH(aq)*
OF: *(Voeg) water/H_2O (by)* (1)
[15]

QUESTION 5/*VRAAG 5*

5.1 B ✓

- The catalyst provides an alternative route of lower activation energy. ✓
- More molecules have enough/sufficient (kinetic) energy./More molecules have (kinetic) energy equal to or higher than the activation energy. ✓
- More effective collisions per unit time./Higher frequency of effective collisions. ✓

- *Die katalisator verskaf 'n alternatiewe roete van laer aktiveringsenergie.*
- *Meer molekule het genoeg/voldoende (kinetiese) energie./Meer molekule het (kinetiese) energie gelyk aan of groter hoër as die aktiveringsenergie.*
- *Meer effektiewe botsings per eenheidtyd./Hoër frekwensie van effektiewe botsings.* (4)

5.2 Y ✓✓ (2)

5.3
5.3.1 560 (cm^3) / 0,56 dm^3 ✓✓ (2)

5.3.2 **POSITIVE MARKING FROM QUESTION 5.3.1.**
POSITIEWE NASIEN VANAF VRAAG 5.3.1.

Marking criteria:	***Nasienkriteria:***
(a) Substitute 24 000 and 560/24 and 0,56 in $n = \frac{V}{V_m}$ ✓ (b) USE mol ratio: $n(H_2O) : n(O_2) = 2 : 1$ ✓ (c) Substitute 18 and $n(H_2O)$ in $m = nM$ ✓ (d) Final answer: 0,83 g ✓ Range: 0,72 to 0,9 g	*(a) Vervang 24 000 en 560/24 en 0,56 in* $n = \frac{V}{V_m}$ ✓ *(b) GEBRUIK molverhouding:* $n(H_2O) : n(O_2) = 2 : 1$ ✓ *(c) Vervang 18 en* $n(H_2O)$ *in* $m = nM$ ✓ *(d) Finale antwoord: 0,83 g* ✓ *Gebied: 0,72 tot 0,9 g*
OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$n(O_2) = \frac{V}{V_m}$ $= \frac{560}{24\ 000}$ ✓**(a)** $= 0,023$ mol (0,0233) $n(H_2O) = 2n(O_2)$ $n(H_2O) = 2(0,023)$ ✓**(b)** $= 0,046$ mol (0,0467) $m = nM$ $= 0,046 \times 18$ ✓**(c)** $= 0,83$ g ✓**(d)**	1 mol ....24 000 cm^3 x mol ....560 cm^3 ✓**(a)** x = 0,023 mol (0,0233) $n(H_2O) = 2n(O_2)$ $n(H_2O) = 2(0,023)$ ✓**(b)** $= 0,046$ mol (0,0467) $m = nM$ $= 0,0466 \times 18$ ✓**(c)** $= 0,83$ g ✓**(d)**

(4)

5.4
5.4.1 0 ($g \cdot s^{-1}$) / zero / *nul* ✓ (1)

5.4.2 Greater than/*Groter as* ✓ (1)

DEPARTMENT OF BASIC EDUCATION
PRIVATE BAG X895, PRETORIA 0001
2022 -11- 28
APPROVED MARKING GUIDELINE
PUBLIC EXAMINATION

5.4.3

Marking criteria

a) Substitute 0,9 g in $\frac{m}{M}$ ✓
b) Substitute 32 in $\frac{m}{M}$ ✓
c) USE mol /rate ratio: $n(H_2O_2) : n(O_2) = 2 : 1$ ✓
d) Substitute 2,1 x 10^{-3} and $n(H_2O_2)$ in rate formula ✓
OR: Substitute rate O_2 (1,05 x 10^{-3}) and $n(O_2)$ in rate formula
OR: Substitute rate O_2 (0,0336 $g{\cdot}s^{-1}$) in rate formula
e) Final correct answer: 26,67 (s) ✓
Range: 26,67 to 28,57 (s)

Nasienkriteria:

a) Vervang 0,9 g in $\frac{m}{M}$ ✓
b) Vervang 32 in $\frac{m}{M}$ ✓
c) GEBRUIK mol-/tempoverhouding: $n(H_2O_2) : n(O_2) = 2 : 1$ ✓
d) Vervang 2,1 x 10^{-3} *en* $n(H_2O_2)$ *in tempoformule* ✓
OF: *Vervang tempo* O_2 (1,05 x 10^{-3}) *en* $n(O_2)$ *in tempoformule*
OF: *Vervang tempo* O_2 *(0,0336* $g{\cdot}s^{-1}$*) in tempoformule*
e) Finale korrekte antwoord: 26,67 (s) ✓
Gebied: 26,67 tot 28,57 *(s)*

OPTION 1/*OPSIE 1*

$n(O_2) = \frac{m}{M}$
$= \frac{0,9 \checkmark(a)}{32 \checkmark(b)}$
$= 0,028$ mol (0,0281)

$n(H_2O_2) = 2n(O_2)$
$= 2(0,028) \checkmark(c)$
$= 0,056$

rate/*tempo* $= \frac{\Delta n}{\Delta t}$

$2,1 \times 10^{-3} = \frac{0,056 - 0}{\Delta t} \checkmark(d)$

$\Delta t = 26,67$ (s) ✓(e)

OPTION 2/*OPSIE 2*

1 mol ………………32 g ✓(b)
x mol ………………0,9 g ✓(a)
x = 0,0275 mol
$n(H_2O_2) = 2n(O_2)$
$= 2(0,0275) \checkmark(c)$
$= 0,056$ mol

rate/*tempo* $= \frac{\Delta n}{\Delta t}$
$2,1 \times 10^{-3} = \frac{0,056 - 0}{\Delta t} \checkmark(d)$
$\Delta t = 26,67$ (s) ✓(e)

OPTION 3/*OPSIE 3*

$n(O_2) = \frac{m}{M}$
$= \frac{0,9 \checkmark(a)}{32 \checkmark(b)}$
$= 0,028$ mol (0,0281)

$Rate(O_2) = ½ \, rate(H_2O_2)$
$= ½ (2,1 \times 10^{-3}) \checkmark(c)$
$= 1,05 \times 10^{-3}$

rate/*tempo* $= \frac{\Delta n}{\Delta t}$
$1,05 \times 10^{-3} = \frac{0,028}{\Delta t} \checkmark(d)$

$\Delta t = 26,67$ (s) ✓(e)

OPTION 4/*OPSIE 4*

rate $H_2O_2 = 2,1 \times 10^{-3}$ $mol{\cdot}s^{-1}$

$Rate(O_2) = ½ \, rate(H_2O_2)$
$= ½ (2,1 \times 10^{-3}) \checkmark(c)$
$= 1,05 \times 10^{-3}$
In one second:
$n(O_2) = \frac{m}{M}$
$1,05 \times 10^{-3} = \frac{m}{32 \checkmark(b)}$
$m(O_2) = 0,0336$ g

rate = 0,0336 $g{\cdot}s^{-1}$
rate $= \frac{\Delta m}{\Delta t}$
$0,0336 = \frac{0,9 - 0 \checkmark(a)}{\Delta t} \checkmark(d)$
$\Delta t = 26,79$ (s) ✓(e)

(5)
[19]

QUESTION 6/*VRAAG 6*

6.1

Marking criteria/*Nasienkriteria*
If any one of the underlined key phrases in the **correct context** is omitted, deduct 1 mark./*Indien enige van die onderstreepte frases in die* ***korrekte konteks*** *uitgelaat is, trek 1 punt af.*

When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will cancel/oppose the disturbance. ✓✓
Wanneer die ewewig in 'n geslote sisteem versteur word, sal die sisteem 'n nuwe ewewig instel deur die reaksie te bevoordeel wat die versteuring kanselleer/teenwerk. (2)

6.2

$$K_c = \frac{[CS_2]}{[S]^2} \checkmark$$

$$\overset{\checkmark}{9{,}4} = \frac{0{,}5 \checkmark}{[S]^2}$$

$[S] = 0{,}23\ mol{\cdot}dm^{-3}$ ✓

NOTE/*LET WEL*
• Wrong K_c expression/*Verkeerde K_c-uitdrukking*: Max./*Maks.* $^2/_4$ • No K_c expression but correct substitution/*Geen K_c-uitdrukking but korrekte vervanging: Max/Maks.* $^3/_4$

(4)

6.3 Increases/*Neem toe* ✓ (1)

6.4

- Increasing/doubling the volume will decrease the pressure. ✓
- The reaction that produces a greater number of moles/amount of gas (1 mole gas to 2 moles gas) is favoured. ✓
- Reverse reaction is favoured. ✓

- *Verhoging/verdubbeling van volume sal die druk verlaag.*
- *Die reaksie wat 'n groter aantal mol/hoeveelheid gas (1 mol gas na 2 mol gas) lewer word bevoordeel.*
- *Terugwaartse reaksie word bevoordeel.*

(3)

6.5 **POSITIVE MARKING FROM 6.2./*POSITIEWE NASIEN VAN VRAAG 6.2.***

CALCULATIONS USING CONCENTRATION
BEREKENINGE WAT KONSENTRASIE GEBRUIK

Marking criteria*:*
(a) Initial concentration is halved. ✓
(b) Change in $[CS_2]$ and [S] **USING** ratio: $S : CS_2 = 2 : 1$ ✓
(c) Equilibrium [S] = initial [S] + change in [S] ✓
(d) Equilibrium $[CS_2]$ = initial $[CS_2]$ - change in $[CS_2]$ ✓
(e) ***CORRECT*** final answer. ✓

Nasienkriteria:
(a) Aanvanklike konsentrasie is gehalveer. ✓
(b) Verandering in $[CS_2]$ en [S] deur ***GEBRUIK*** *van verhouding $S : CS_2 = 2 : 1$* ✓
(c) Ewewig [S] = aanvanklike [S] + verandering in [S] ✓
(d) Ewewig $[CS_2]$ = aanvanklike $[CS_2]$ - verandering in $[CS_2]$ ✓
(e) ***KORREKTE*** *finale antwoord.* ✓

OPTION 1/*OPSIE 1*

	S	CS_2	
Initial concentration ($mol \cdot dm^{-3}$) *Aanvangskonsentrasie ($mol \cdot dm^{-3}$)*	0,23 x ½ = 0,115	0,5 x ½ = 0,25	✓(a)
Change in concentration ($mol \cdot dm^{-3}$) *Verandering in konsentrasie ($mol \cdot dm^{-3}$)*	2x	x	✓(b)
Equilibrium concentration ($mol \cdot dm^{-3}$) *Ewewigskonsentrasie ($mol \cdot dm^{-3}$)*	0,115 + 2x	0,25 - x	
	✓(c)	✓(d)	

$$K_c = \frac{[CS_2]}{[S]^2}$$

$$9{,}4 = \frac{0{,}25 - x}{(0{,}115 + 2x)^2} \checkmark\text{(e)}$$

Wrong K_c expression
Verkeerde K_c- uitdrukking: Max./Maks. $^4/_5$

CALCULATIONS USING NUMBER OF MOLES
BEREKENINGE WAT GETAL MOL GEBRUIK
Marking criteria:
(a) n(initial) = c(initial) x 2. ✓
(b) Change in n(S) and n(CS_2) **USING** ratio: S : CS_2 = 2 : 1 ✓
(c) Equilibrium n(S) = initial n(S) + change in n(S) ✓
(d) Equilibrium n(CS_2) = initial n(CS_2) - change in n(CS_2) ✓
(e) **CORRECT** final answer. ✓

Nasienkriteria:
(a) n(aanvanklik) = c(aanvanklik) x 2 ✓
(b) Verandering in n(S) en n(CS_2) deur ***GEBRUIK*** *van verhouding: S : CS_2 = 2 : 1* ✓
(c) Ewewig n(S) = aanvanklike n(S) + verandering in n(S) ✓
(d) Ewewig n(CS_2) = aanvanklike n(CS_2) - verandering in n(CS_2) ✓
(e) ***KORREKTE*** *finale antwoord.* ✓

OPTION 2/*OPSIE 2*

	S	CS_2	
Initial quantity (mol) *Aanvangshoeveelheid (mol)*	0,46	1	✓(a)
Change (mol) *Verandering (mol)*	8x	4x	✓(b)
Quantity at equilibrium (mol)/ *Hoeveelheid by ewewig (mol)* ✓(c)	0,46 + 8x	1 – 4x	✓(d)
Equilibrium concentration (mol·dm^{-3}) *Ewewigskonsentrasie (mol·dm^{-3})*	$\frac{0,46 + 8x}{4}$	$\frac{1 - 4x}{4}$	

$$K_c = \frac{[CS_2]}{[S]^2}$$

$$9,4 = \frac{\frac{1-4x}{4}}{\left(\frac{0,46+8x}{4}\right)^2} \checkmark\text{(e)}$$

Wrong K_c expression
Verkeerde K_c-uitdrukking: Max./*Maks.* $^4/_5$

(5)

6.6

6.6.1 (Chemical) equilibrium / Rate of the forward and reverse reactions are equal. / Concentrations of reactants and products are constant. ✓
(Chemiese) ewewig / Tempo van voorwaartse en terugwaartse reaksie dieselfde./Konsentrasies van reaktante en produkte is konstant. (1)

6.6.2 Increase in the amount/concentration of S/reactant **OR** S was added. ✓
Toename in die hoeveelheid/konsentrasie S/reaktans ***OF*** *S is bygevoeg.* (1)

6.6.3 Decrease in temperature/*Verlaging in temperatuur* ✓ (1)

DEPARTMENT OF BASIC EDUCATION
PRIVATE BAG X895, PRETORIA 0001
2022 -11- 28
APPROVED MARKING GUIDELINE
PUBLIC EXAMINATION

6.6.4
- The rates of the forward and reverse reactions decrease. ✓
- The reverse reaction is favoured / faster than the forward reaction.
  OR
  The forward reaction decreases more. ✓
- A decrease in temperature favours the exothermic reaction. ✓

- *Die voorwaartse en terugwaartse reaksietempo neem af.*
- *Die terugwaartse reaksie word bevoordeel/is vinniger as die voorwaartse reaksie.*
  OF
  Die voorwaartse reaksie neem meer af.
- *'n Verlaging in die temperatuur bevoordeel die eksotermiese reaksie.* (3)

[21]

QUESTION 7/*VRAAG 7*

7.1

7.1.1 (An acid is a) proton donor/H^+ (ion) donor. ✓✓ **(2 or 0)**
('n Suur is 'n) protonskenker/H^+(-ioon) skenker. ***(2 of 0)*** (2)

7.1.2 (Weak acids) ionise/dissociate incompletely/partially (in water)/have a low K_a value. ✓
(Swak sure) ioniseer/dissosieer onvolledig/gedeeltlik (in water)/het 'n lae K_a-waarde. (1)

7.1.3 H_2O ✓ and CH_3COO^- ✓ (2)

7.2

7.2.1 n(NaOH) = cV ✓
n = $\underline{(0,167)(0,300)}$ ✓
∴ n(NaOH) = 0,05 mol ✓ (5×10^{-2} mol) (3)

DEPARTMENT OF BASIC EDUCATION
PRIVATE BAG X895, PRETORIA 0001
2022 -11- 28
APPROVED MARKING GUIDELINE
PUBLIC EXAMINATION

7.2.2

Marking criteria:	***Nasienkriteria:***
a) Any formula: $pH = -\log[H_3O^+]$ / $pH = -\log[H^+]$ / $pOH = -\log[OH^-]$ / $[H_3O^+][OH^-] = 10^{-14}$ / $pH + pOH = 14$ ✓ b) Substitute 11,4 in $pH = -\log[H_3O^+]$/ $pH + pOH = 14$ ✓ c) Substitute calculated $[H_3O^+]$ in $[H_3O^+][OH^-]$ / 2,6 in $pOH = -\log[OH^-]$ ✓ d) Final answer: $2,51 \times 10^{-3}$ mol·dm^{-3} ✓ (0,003 mol·dm^{-3})	*a)* Enige formule: $pH = -\log[H_3O^+]$ / $pH = -\log[H^+]$ / $pOH = -\log[OH^-]$ / $[H_3O^+][OH^-] = 10^{-14}$ / $pH + pOH = 14$ ✓ *b) Vervang* 11,4 in $pH = -\log[H_3O^+]$/ $pH + pOH = 14$ ✓ *c) Vervang berekende* $[H_3O^+]$ in $[H_3O^+][OH^-]$ / 2,6 in $pOH = -\log[OH^-]$ ✓ *d) Finale antwoord:* $2,51 \times 10^{-3}$ mol·dm^{-3} ✓ (0,003 mol·dm^{-3})

OPTION 1/*OPSIE 1*

$pH = -\log[H_3O^+]$

$11,4$ ✓(b) $= -\log[H_3O^+]$ **OR/*OF*** $[H_3O^+] = 10^{-11,4}$ Any one/*Enige een* ✓(a)

$[H_3O^+] = 3,98 \times 10^{-12}$

$[H_3O^+][OH^-] = 10^{-14}$

✓(c)

$(3,98 \times 10^{-12})[OH^-] = 1 \times 10^{-14}$

$[OH^-] = 2,51 \times 10^{-3}$ mol·dm^{-3} ✓(d) (0,003)

OPTION 2/*OPSIE 2*

$pH + pOH = 14$

$\underline{11,4 + pOH = 14}$ ✓(b) Any one/*Enige een* ✓(a)

$pOH = 2,6$

$pOH = -\log[OH^-]$ ✓

$2,6$ ✓(c) $= -\log[OH^-]$

$[OH^-] = 2,51 \times 10^{-3}$ mol·dm^{-3} ✓(d) (0,003)

(4)

DEPARTMENT OF BASIC EDUCATION
PRIVATE BAG X895, PRETORIA 0001
2022 -11- 28
APPROVED MARKING GUIDELINE
PUBLIC EXAMINATION

7.2.3 **POSITIVE MARKING FROM QUESTION 7.2.1. AND 7.2.2.**
POSITIEWE NASIEN VANAF VRAAG 7.2.1. EN 7.2.2.

Marking criteria:

a) Substitute [NaOH] = 0,00251 mol·dm^{-3} (answer from Q7.2.2) and 0,8 in $c = \frac{n}{V}$ ✓
b) Subtract: $n(NaOH)_{initial}$ (from Q7.2.1) – $n(NaOH)_{mixture}$ ✓✓
c) Use of ratio: $n(OH^-) = n(CH_3COOH)$ ✓
d) Substitute 0,5 and $\Delta n(CH_3COOH)$[calculated by subtraction] into $c = \frac{n}{V}$ ✓
e) Final correct answer: 0,096 mol·dm^{-3} ✓
Range: 0,095 to 0,1 mol·dm^{-3}

Nasienkriteria:

a) *Vervang [NaOH] = 0,00251 mol·dm^{-3} (antwoord van Q7.2.2) en 0,8 in* $c = \frac{n}{V}$ ✓
b) *Trek af:* $n(NaOH)_{aanvanklik}$ *(vanaf Q7.2.1)* – $n(NaOH)_{mengsel}$ ✓✓
c) *Gebruik verhouding:* $n(OH^-) = n(CH_3COOH)$ ✓
d) *Vervang 0,5 en* $\Delta n(CH_3COOH)$ *[bereken deur aftrekking] in* $c = \frac{n}{V}$ ✓
e) *Finale korrekte antwoord: 0,096 mol·dm^{-3}* ✓
Gebied: 0,095 tot 0,1 mol·dm^{-3}

n(NaOH)mixture = cV
= 0,00251 x 0,8 ✓**(a)**
= 0,002 mol (0,0024)

$n(NaOH)_{reacted}$ = 0,05 – 0,002 ✓✓**(b)**
= 0,048 mol (0,0476)

$n(NaOH)_{reacted} = n(CH_3COOH)_{used}$
= 0,048 mol ✓**(c)**

$[CH_3COOH] = \frac{n}{V}$
$= \frac{0,048}{0,5}$ ✓**(d)**
= 0,096 mol·dm^{-3} ✓**(e)**
(0,0952)

NOTE/*LET WEL*
IF/*INDIEN:*

- $\frac{c_aV_a}{c_bV_b} = \frac{1}{1}$ Max./*Maks.* $^1/_6$
- Answer from Q7.2.1 substituted in $c = \frac{n}{V}$ to obtain an answer of 0,01 mol·dm^{-3}./
Antwoord van Q7.2.1 vervang in $c = \frac{n}{V}$ *om 0,01 mol·dm^{-3} as antwoord te kry.*
Max./*Maks.* $^1/_6$

(6)
[18]

DEPARTMENT OF BASIC EDUCATION
PRIVATE BAG X895, PRETORIA 0001
2022 -11- 28
APPROVED MARKING GUIDELINE
PUBLIC EXAMINATION

QUESTION 8/*VRAAG 8*

8.1

8.1.1 Zn/zinc/*sink* ✓ (1)

8.1.2 MnO_4^- is a stronger oxidising agent ✓ than Zn^{2+}/Zn(II) ions ✓ and will oxidise Zn ✓ (to Zn^{2+}/Zn(II) ions).
MnO_4^- is 'n sterker oksideermiddel as Zn^{2+}/Zn(II)-ione en sal Zn oksideer (na Zn^{2+}/Zn(II)-ione).

OR/*OF*
Zn^{2+}/Zn(II) ion is a weaker oxidising agent ✓ than MnO_4^- ✓ and therefore MnO_4^- will be reduced ✓ (to Mn^{2+}/Mn(II) ions).
Zn^{2+}/Zn(II) ione is 'n swakker oksideermiddel as MnO_4^- en dus word MnO_4^- gereduseer (to Mn^{2+}/Mn(II)-ione). (3)

8.2

8.2.1 Provides path for movement of ions. / Completes the circuit. / Ensures electrical neutrality in the cell. / Restore charge balance. ✓

Verskaf pad vir beweging van ione. / Voltooi die stroombaan. / Verseker elektriese neutraliteit in die sel. / Herstel balans van lading. (1)

8.2.2 Mn to/*na* Ni ✓✓ (2)

8.2.3

<table>
<tr><td><u>OPTION 1/OPTION 1</u>
$E^\theta_{cell} = E^\theta_{reduction} - E^\theta_{oxidation}$ ✓
$= -0{,}27$✓$- (-1{,}18)$✓
$= 0{,}91$ V ✓</td><td><u>NOTE/LET WEL</u>
• Accept any other correct formula from the data sheet. /Aanvaar enige ander korrekte formule vanaf gegewensblad.
• Any other formula using unconventional abbreviations, e.g. $E°_{cell} = E°_{OA} - E°_{RA}$ followed by correct substitutions:/Enige ander formule wat onkonvensionele afkortings gebruik, bv. $E°_{sel} = E°_{OM} - E°_{RM}$ gevolg deur korrekte vervangings $^3/_4$</td></tr>
<tr><td colspan="2"><u>OPTION 2/OPSIE 2</u>
✓ $Ni^{2+} + 2e^- \rightarrow Ni$ E = -0,27 ✓
   $Mn \rightarrow Mn^{2+} + 2e^-$ E = 1,18 ✓
$Ni^{2+} + Mn \rightarrow Mn^{2+} + Ni$ E = 0,91 V ✓</td></tr>
</table>

(4)

8.2.4 $Ni^{2+} + Mn$ ✓ $\rightarrow Mn^{2+} + Ni$ ✓ Bal. ✓

<u>Marking criteria/*Nasienkriteria:*</u>
• Reactants ✓ Products ✓ Balancing ✓ *Reaktanse* ✓ *Produkte* ✓ *Balansering* ✓
• Ignore/*Ignoreer* ⇌ and phases/*en fases*
• Marking rule 6.3.10/*Nasienreël 6.3.10*

(3)

8.2.5 Increase/*Toeneem* ✓ (1)
[15]

QUESTION 9/*VRAAG 9*

9.1 **ANY ONE:**

- The chemical process in which electrical energy is converted to chemical energy. ✓✓ **(2 or 0)**
- The use of electrical energy to produce a chemical change.
- The process during which an electric current passes through a solution / molten ionic compound.

ENIGE EEN:

- *Die chemiese proses waarin elektriese energie omgeskakel word na chemiese energie.* ***(2 of 0)***
- *Die gebruik van elektriese energie om 'n chemiese verandering te veroorsaak.*
- *Die proses waar 'n elektriese stroom deur 'n oplossing / gesmelte ioniese verbinding beweeg.*

(2)

9.2.1 $Cr^{3+}(aq) + 3e^- \rightarrow Cr$ ✓✓

Marking criteria/*Nasienkriteria:*

- $Cr \leftarrow Cr^{3+}(aq) + 3e^-$ $(\frac{2}{2})$
  $Cr^{3+}(aq) + 3e^- \rightleftharpoons Cr$ $(\frac{1}{2})$
  $Cr \rightleftharpoons Cr^{3+}(aq) + 3e^-$ $(\frac{0}{2})$
  $Cr^{3+}(aq) + 3e^- \leftarrow Cr$ $(\frac{0}{2})$
- Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.*
- If charge (+) omitted on Cr^{3+}/*Indien lading (+) weggelaat op* Cr^{3+}:
  Example/*Voorbeeld:* $Cr^{3}(aq) + 3e^- \rightarrow Cr$ Max./*Maks:* $\frac{1}{2}$

(2)

9.2.2 $q = I\Delta t$ ✓
$= (2,5)(10 \times 60 \times 60)$ ✓
$= 9 \times 10^4$ C ✓ (90 000 C)

(3)

9.2.3 **POSITIVE MARKING FROM QUESTION 9.2.2.**
POSITIEWE NASIEN VANAF VRAAG 9.2.2.

Marking criteria:	***Nasienkriteria:***
a) Substitute $1,6 \times 10^{-19}$ C in $n = \frac{Q}{e}$ ✓	a) *Vervang* $1,6 \times 10^{-19}$ *C in* $n = \frac{Q}{e}$ ✓
b) N(Cr) = n(electrons) divide by 3 ✓	b) *N(Cr) = n(elektrone) gedeel deur 3* ✓
c) n(Cr) = N(Cr) divided by N_A ✓	c) *n(Cr) = N(Cr) gedeel deur* N_A ✓
d) Substitution of 52 into $n = \frac{m}{M}$ ✓	d) *Vervang 52 in* $n = \frac{m}{M}$ ✓
e) m(Cr) $\underline{+\ 2,2}$ ✓	e) *m(Cr)* $\underline{+\ 2,2}$ ✓
f) Final answer: 18,32 (g) ✓ Range: *18,32 to 18,40* (g)	f) *Finale antwoord: 18,32 (g)* ✓ *Gebied: 18,32 tot 18,40 (g)*

NOTE/*LET WEL*

IF used: $Cr^{2+}(aq) + 2e^- \rightarrow Cr$ in QUESTION 9.2.1, accept division by 2 for criteria b).

INDIEN: $Cr^{2+}(aq) + 2e^- \rightarrow Cr$ *gebruik in VRAAG 9.2.1, aanvaar deel deur 2 vir kriteria b).*

Final answer will then be:/ *Finale antwoord is dan:* 26,49 g
Range/ *Gebied*: 26,49 to/*tot* 26,64 (g)

OPTION 1/*OPSIE 1*

$$n = \frac{Q}{e} / \frac{Q}{q_e}$$
$$= \frac{9 \times 10^4}{1,6 \times 10^{-19}} \checkmark\text{(a)}$$
$$= 5,63 \times 10^{23} \text{ electrons}$$

$$N(\text{Cr atoms}) = \frac{5,63 \times 10^{23}}{3 \checkmark\text{(b)}}$$
$$= 1,88 \times 10^{23}$$

$$n(Cr) = \frac{N}{N_A}$$
$$= \frac{1,88 \times 10^{23}}{6,02 \times 10^{23}} \checkmark\text{(c)}$$
$$= 0,31 \text{ mol}$$

$$n(Cr) = \frac{m}{M}$$
$$m(Cr) = 0,31 \times 52 \checkmark\text{(d)}$$
$$= 16,12 \text{ g}$$

$$m(X) = 16,12 \ \underline{+\ 2,2} \checkmark\text{(e)}$$
$$= 18,32 \text{ (g)} \checkmark\text{(f)}$$

OPTION 2/*OPSIE 2*

$$n(Cr) = \frac{9 \times 10^4}{3 \times 96\,500} \checkmark\checkmark\text{(a \& c)}$$
✓(b)
$$= 0,31 \text{ mol}$$

$$m(Cr) = 0,31 \times 52 \checkmark\text{(d)}$$
$$= 16,12 \text{ g}$$

$$m(X) = 16,12 \ \underline{+\ 2,2} \checkmark\text{(e)}$$
$$= 18,32 \text{ (g)} \checkmark\text{(f)}$$

(6)
[13]

TOTAL/*TOTAAL*: 150