Province of the
EASTERN CAPE
EDUCATION

EXAMINATIONS AND ASSESSMENT CHIEF DIRECTORATE
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2020 NSC CHIEF MARKER'S REPORT

SUBJECT:	**PHYSICAL SCIENCES**
PAPER:	**TWO**
DURATION OF PAPER:	**3 HOURS**

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

The candidates' AVERAGE SCORE for the paper is **36%** (based on the 100 scripts sample).
In the MULTIPLE-CHOICE questions, Question 1.1 had the highest performance with an average of **82 %** and Question 1.2 the lowest performance with **14 %**
In the CONTEXTUAL questions, Question 2 (Basic Organic Molecules) had the highest performance with average score of **50 %** followed by Question 3 (Physical Properties) and Question 4 (Organic reactions) with **41 %**.
Both Questions 5 (Reaction Rates) and 7 (Acids and Bases) had the worst learner performance with a score of **30 %**.

SEVEN POINT SCALE REFLECTING AND COMPARISON WITH LAST YEAR

2019			2020		
LEVEL	**TOTAL**	**%**	**LEVEL**	**TOTAL**	**%**
1	14 007	50,6	**1**	20 478	67,2
2	5 243	18,9	**2**	4 130	13,3
3	3 490	12,6	**3**	2 531	8,3
4	2 276	8,2	**4**	1 581	5,2
5	1 416	5,1	**5**	934	3,1
6	793	2,9	**6**	534	1,8
7	440	1,6	**7**	729	0,9
TOTAL WROTE		*27 647*	***TOTAL WROTE***		*30 467*
TOTAL PASSED		*49,4 %*	***TOTAL PASSED***		*32,8 %*

Learners performed poorly in this paper as illustrated in the graph labelled "Performance per Question". All the topics done after term 1 (Rates of reaction (Q. 5 30%), Chemical equilibrium (Q. 6 34%), Acids and Bases (Q. 7 30%), electrochemistry (Q. 8 37%) and (Q. 9 31%) and fertilisers (Q 10. 34%) performed poorly. Teachers may have rushed to finish the syllabus, first in preparation for the Trial exam and for the final exam. I do not think enough informal assessments were given to learners to assist them to learn and master the content and skills in science. Question 2 showed a better performance of 50% relative to the other questions. This question was bases on content covered during the first term and it was basic concepts in organic chemistry.

The average learner score was 36% for the 2020 Physical Sciences Paper 2 Examination.

The candidates' average score for the paper is 36% (based on the 100 scripts sample). The 2019 sample had 51% average score. The learners' score this year has decreased significantly.

Question 2 BASIC ORGANIC MOLECULES showed a better performance of 50%.

Question 9 showed an improvement from last year's 27% to 31% this year. The score is still low but there has been an improvement - this can be attributed to the fact the question in 2019 was tougher than what was asked this year.

Very few subquestions were well answered by candidates:

1.1 Organic Chemistry (82 %)

2.1 Homologous series and IUPAC name of isomers (54 %)

2.2 IUPAC name and structural formulae (54 %)

3.1 Boiling point definition (84 %)

6.2 Effect of pressure change on Kc and number of reactants (68 %)

8.5 EMF calculation (57 %)

9.2 Identification of type of cell (60 %)

The following subquestions were poorly answered by candidates:

1.2 Empirical formula (14 %)

3.1 Structural formula of the functional group (23 %)

4.3 Elimination reaction (16 %)

5.2 Deductions from a graph (13 %)

6.4 Le Chatelier's principle (26 %)

8.6 Comparing strengths of reducing agents (5 %)

9.4 Concentration of electrolyte during electroplating (11 %)

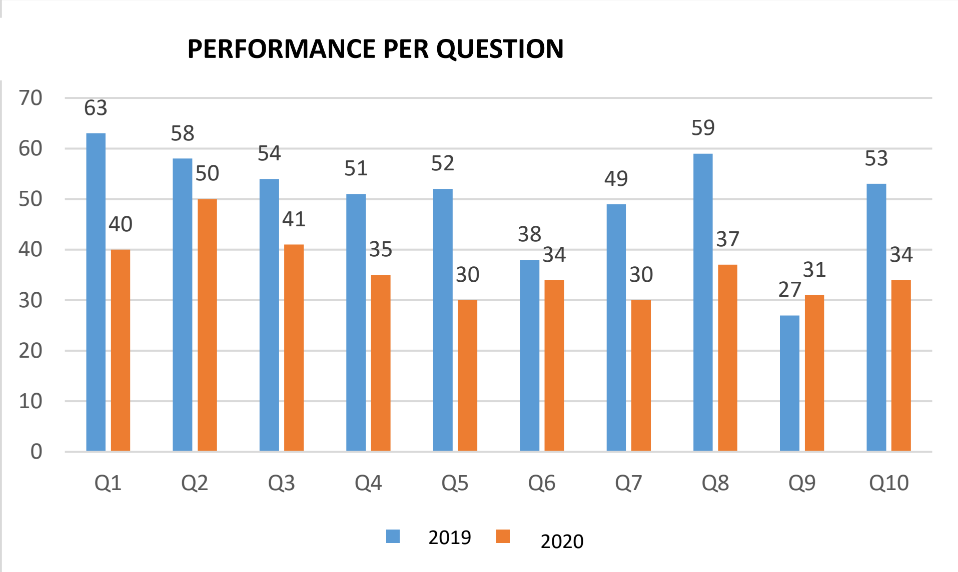
10.2 Calculation in fertilisers (31.1 %)

THE TABLE BELOW SHOWS COMPARISON OF PERFORMANCE IN 2019 AND 2020.

QUESTION	AVERAGE PERFOMANCE IN 2019 (%)	AVERAGE PERFORMANCE IN 2020 (%)	CHANGE (%)
Q1	63	40	-23
Q2	58	50	-8
Q3	54	41	-13
Q4	51	35	-16
Q5	52	30	-22
Q6	38	34	-4
Q7	49	30	-19
Q8	59	37	-22
Q9	27	31	+4
Q10	53	34	-19

HUGE VARIATION IN THE SCORES per question are evident in the table. The biggest variations occur in questions 5 to Q10 (except Q9). All these topics were done after term 1.

The information in the table illustrated graphically below.



SECTION 2: Comment on candidates' performance in individual questions
(It is expected that a comment will be provided for each question on a separate sheet).

QUESTION 1
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
The average score for this question was **41 %**. Candidates' performance in this question was MODERATE. Sub-question 1.1 showed the highest performance at 82% while Q1.2 showed the lowest performance at 14 %.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
1.1 Candidates need to memorise the general formula for all homologous series.
1.2 Many candidates picked the molecular formula for hexanoic acid but failed to work out the empirical formula.
1.3 Naming and structural formula for the ester was not understood by some candidates.
1.4 Candidates should know that if the concentration of a substance increases then the reaction rate will also increase.
1.5 Candidates had to know the definition of a catalyst.
1.6 This question had two parts. In the first part the candidates had to know that to favour the forward reaction, the temperature of the system had to decrease so that the system can increase the temperature by favouring the exothermic (forward) reaction. In the second part the candidates had to know that a decrease in the pH will increase the concentration of the Hydrogen ion (H^+), the system will therefore favour the forward reaction by decreasing the concentration of the Hydrogen ion.
1.7 To form a conjugate base, some candidates failed to understand that the $HPO4^{-2}$ will have to donate a proton (H^+)
1.8 Many candidates failed to use oxidation numbers to see what is oxidised and be able to compare strengths of reducing agents and/or oxidising agents
1.9 Candidates knew that anode loses mass but failed to understand that the mass of the anode cannot start at zero because the anode was there at the start of the reaction.
1.10 Many candidates including gifted candidates failed to distinguish between what causes eutrophication and the process of eutrophication itself.

(c) Provide suggestions for improvement in relation to Teaching and Learning.
The answering of multiple-choice questions is a SKILL that needs to be developed. Candidates must be guided to eliminate the wrong answers through regular practice and assessment. Multiple-choice questions must be assessed on a regular basis on all topics covered.
Educators also need to revise the grade 11 work in preparation for the final exam, for example empirical formula.
Subject advisors can compile a workbook containing multiple choice questions from previous years, per topic, and distribute to schools for educators and candidates to use effectively.
More practice on multiple-choice questions. Include multiple-choice questions in short tests as well.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
If a candidate is not familiar with the general formulae of the homologous series (question 1.1) then the candidate will also struggle with the empirical formula for question 1.2.
Candidates need to know how to determine the empirical formula of an organic compound from its molecular formula. Educators must let the candidates practise this while teaching the different formulae for organic chemistry.
Assist learners in remembering terms associated with the anode-then those that are associated with cathode are the opposites.
Special attention must be given to the common ion effect when teaching chemical equilibrium, especially linking it with pH, acids $[H^+]$ and bases $[OH^-]$
Advise learners to calculate EMF of cells when a reaction is given to determine whether the reaction is spontaneous or not. Learners have to know how to determine the reducing agent/oxidising agent when given a reaction.
Candidates struggled with question 1.10. All the options had something to do with eutrophication, but the question clearly stated the cause of eutrophication. And according to the definition, as it is in the Examination Guidelines, "Eutrophication as a process by which an ecosystem becomes enriched with inorganic plant nutrients..."

QUESTION 2
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
The average score for this question was **50 %.** Candidates' performance in this question was MODERATE. Subquestions 2.1. and 2.2 scored the highest at 54 % while Q2.3 showed the lowest performance at 43%.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
2.1.2 Candidates tend to number the position of the functional group of the aldehydes, for example Pentan-1-al or 1-Pentanal-which is incorrect as the functional group of aldehydes a (and carboxylic acids) is always in position 1.
2.2.1 Finer details on IUPAC naming rules were missed by teachers (even schools with excellent performance). Most of the candidates struggled to give the IUPAC name of 5-bromo-2,3-dimethylhecane. Most candidates could identify the correct stem and all the substituents, but they struggled with the numbering and the sequence. The general answer that was given by candidates was 4,5-dimethyl-2-bromohexane or 2-bromo-4,5-dimethylhexane.
2.2.2 Carelessness – 5 bonds per C-atom or bonds and/ or hydrogen atoms omitted. In some candidates' responses the functional group of the alkynes were not known by learners.
2.3.1 A common error is that candidates write that the functional group is bonded to the first or the last C-atom or end /terminal carbon. Candidates also incorrectly refer to the hydroxyl group as the hydroxide ion for the naming of the functional group of an alcohol.
2.3.3 Candidates struggled to identify the molecular formula of 1-propanol as an alcohol and therefore could not name the carboxylic acid that would be needed to form the ester propyl butanoate.

(c) Provide suggestions for improvement in relation to Teaching and Learning.
Rules on nomenclature should be taught and practised very well. Look at the "2017 Examination Guidelines" for the naming of halo alkanes with side chains as was asked in question 2.2.1. Educators must teach the candidates to always look for the smallest numbering sequence when it comes to the IUPAC naming of halo alkanes with side chains.
Educators should refer to the exam guidelines and read them before starting any topic.
Thorough revision must be done before or after the trial examination to recap important aspects of organic chemistry as this topic was done during term 1 and candidates tends to forget the basics of organic chemistry.
When teaching IUPAC naming encourage candidates to use the correct method for IUPAC naming, for example 3-Pentanone instead of Pentan-3-one.
Candidates should also be made aware that no numbering is used for the position of the functional group when it comes to the aldehydes, carboxylic acids, and esters.
Examination Guidelines and the Chief Markers Report should be used WITH the CAPS documents when teaching (so that educators can see the depth/extent of a specific topic).
Examination Guidelines should be used for definitions.
Administer exercises that address the different types of formulae used in organic chemistry especially conversion from condensed structural formulae to structural formula.
Develop exercises that address the different type of isomers – definitions, naming, and structural formulae.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
Carelessness – 5 bonds per C-atom or bonds and/ or hydrogen atoms omitted. In some candidates' responses the functional groups were not known by learners.
Structural vs Molecular vs Condensed formulae should be taught and applied so that learners know the difference and be able to apply it correctly.
More time must be given to candidates to practise drawing structural formulae of organic compounds.
EMPHASISE to candidates that a carbon atom can only make a maximum of 4 bonds.
Candidates refer to the OH group as the functional group of alcohols when explaining primary, secondary and tertiary alcohols. Candidates must be made aware that it is the carbon atom that is attached to the OH group that is bonded to one, two or three other carbon atom(s). If a candidate uses the "functional group" to explain primary, secondary, or tertiary alcohols, then the candidate must write "The functional group is bonded to only one, or two, or three carbon atoms. The candidate should not write that it is bonded to the end or the beginning of the chain.
It is advisable that learners practise writing out the position of the functional group before the parent name e.g., for butan-2–ol rather write 2 –butanol to avoid leaving out the "an".
The practical on esterification must be done in class so that the candidates can familiarise themselves with the naming and origin of esters.
Structural vs Molecular vs Condensed formulae should be taught and applied so that learners know the difference and be able to apply it correctly.

QUESTION 3
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
The average score for this question was **41 %.** Candidates' performance in this question was MODERATE. Sub-question 3.1 scored the highest at 84 % while sub-question 3.2 showed the lowest performance at 23%.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
3.1 Candidates tended to forget to mention "temperature" in the definition of boiling point and only referred to the vapour pressure that equals the atmospheric (external) pressure. Candidates would also replace the word temperature with "a point". A candidate must refer to a temperature when defining the term "boiling point" Bad teaching practices - teachers need to avoid using words like "point" when defining boiling point OR lack of attentiveness to learners' errors when using unacceptable words in definitions.
3.2 Candidates must memorise the functional groups of all organic compounds. Candidates tend to complete the structural formula by adding more carbon and or hydrogen atoms.
3.3 Candidates struggled to give the whole explanation as there was no guidance given to candidates in term of surface area, intermolecular forces, and energy. There is also a lot of confusion amongst candidates in terms of intermolecular forces and intramolecular bonds. Please make the candidates aware that NO marks are awarded if the candidate refer to the "breaking of **bonds**" instead of "overcoming or breaking of **intermolecular forces**"
3.4.2 Candidates who lost marks in this question did so because they only mentioned the different intermolecular forces of the alkanes (London forces), aldehydes (dipole-dipole forces) and alcohols (hydrogen bonds) without making a comparison of the strengths of these forces. Also, they did not mention which substance has a particular type of intermolecular force. To gain the mark the candidates had to compare the strength of the three different intermolecular forces and then compare the energy needed to overcome the intermolecular forces OR compare the boiling points of the alkanes versus the aldehydes and the aldehydes versus the alcohols.
3.5 Candidates had to know that compound B is an aldehyde and that an aldehyde with 4 C-atoms is Butanal.
3.6 Candidates lost marks when they mentioned the position of the functional group of an aldehyde, e.g., 1-pentanal. Some candidates identified the wrong homologous series and wrote butanol or butane.

(c) Provide suggestions for improvement in relation to Teaching and Learning.
Suggestions for improvement in respect to teaching and learning: • Revision. • Repetition, repetition, repetition. • Past question papers (Guide candidates on how to answer questions, work previous question papers into lesson planning and homework exercises, and guide learners step-by-step on how to answer specific questions).
Examination Guidelines and the Chief Markers Report should be used WITH the CAPS documents when teaching (so that educators can see the depth/extent of a specific topic).
Examination Guidelines should be used for definitions.
Relationships between physical properties and chain length/homogenous series should be re-enforced. Learners must be given exercises questions on how to identify the variable being investigated. Learners need to know that if the compounds whose boiling points are compared belong to: • Same homologous series they must compare (1) surface area (2) strength of London forces (3) energy to overcome intermolecular forces • Different homologous series they must (1) Mention type of force in each compound (2) Compare strength of the forces (3) Compare energy to overcome intermolecular forces

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
Teachers must use wording cautiously when explaining definition and concepts. EMPHASIS MUST BE PLACED ON MEMORISING DEFINITIONS.

QUESTION 4
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
The average score for this question was **35 %.** Candidates' performance in this question was POOR. Sub-question 4.1 scored the highest at 44 % while sub-question 4.3 showed the lowest performance at 16%.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
4.1 Candidates had to identify hydrohalogenation as the addition of a hydrogen and a halogen to an alkene. Candidates lost marks for saying the addition of a "hydrohalgen". Some candidates also stated that hydrohalogenation is the addition or substitution of a hydrogen and a halogen to an alkene. These candidates lost their marks because the substitution of a halogen is called halogenation or nucleophilic substitution.
4.2 Carelessness – 5 bonds per C-atom or bonds and/ or hydrogen atoms omitted. In some candidates' responses the functional group of an alkene is not known by the candidates.
4.3.2 Candidates could not work backwards using the flow diagram.
4.5.1 Candidates that lost marks here lost it because they did not know which reactant to use.
4.5.2 Many candidates still use the term "temperature" instead of "heat" and candidates must be made aware that "dissolving the halo alkane in ethanol" does not carry any marks in the exam.

(c) Provide suggestions for improvement in relation to Teaching and Learning.
Teachers must use wording cautiously when explaining definition and concepts. EMPHASIS MUST BE PLACED ON MEMORISING DEFINITIONS.
Learners should understand the difference between general formula, structural formula, and molecular formula. Teachers need to teach these concepts properly.
Structural vs Molecular vs Condensed formulae should be taught and applied so that learners know the difference and be able to apply it correctly.
Develop exercises where learners work backwards in flow diagrams.
Develop exercises that allow learners to identify type of organic reaction based on reactants used/products formed/reaction conditions.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
It is advisable that there should be in-service training on organic reactions.
Carelessness – 5 bonds per C-atom or bonds and/ or hydrogen atoms omitted. In some candidates' responses the functional groups are not known by learners.
Candidates must be guided in class to read, interpret, and understand flow diagrams for the chemical reactions of organic chemistry.
Candidates must be made aware that "dissolving the halo alkane in ethanol" does not carry any marks for the reaction conditions dot hydrolysis. Only "mild heat" and "a diluted strong base/ water" is accepted.

QUESTION 5
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
The average score for this question was **30 %.** Candidates' performance in this question was POOR. Subquestion scored the highest at 51% while sub-question 5.2 showed the lowest performance at 13 %.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
5.1.1 and 5.1.2 Candidates can still not identify the dependent and independent variables.
5.2.1Candidates did not use the tangent of the gradient of the graph to determine the rate of the reaction. Many candidates wrote that the rate is increasing instead of decreasing. These candidates saw that the volume increase and therefore wrote that the rate of the reaction increase.
5.2.2 Candidates still get confused between a chemical reaction that is not reversible and a chemical reaction that is reversible. Thus, they wrote that the reaction is in "chemical equilibrium" when the gradient of the graph is zero, instead of writing that the reaction rate is zero. The 40-minute label should not have been included in the graph as it confused some learners as they thought that the change in gradient (decreasing in 20 to 40s) is different from what is happening during the interval (40 to 60s). There was just no need for the 40s –leaving it out would have eliminated the confusion. The inclusion of the 40s made the question unnecessarily difficult/confusing. (1 mark) The inclusion of the 40-minute time value also confused learners when calculating the gradient in 5.3. Too many values to choose from and some learners were tricked by the inclusion of the 40-minute time value (3 marks)
5.3 Candidates had to subtract 0 from 500 and 0 from 60, instead the subtracted 460 from 500 and 40 from 60 OR 300 from 460 and 20 from 40. Candidates who got this wrong did not know that CO_2 will be completely produced at 60s, and therefore they used the wrong values from the graph.
5.5 Candidates answered this question well and most candidates could identify the factor that changed as an increase in the surface area of $CaCO_3$. But candidates are still forfeiting marks for omitting the "per unit time" when explaining the collision theory. Candidates must write that there will be more effective collisions per unit time OR a higher frequency of effective collisions.
5.6 Candidates did not read the question carefully, molar volume was given as 25,7 $dm^3.mol^{-1}$ for this question and many candidates used 22,4 $dm^3.mol^{-1}$ as the molar volume. Candidates also use the wrong formula (c=m/MV) instead of n=m/M.

(c) Provide suggestions for improvement in relation to Teaching and Learning.
Teachers must use wording cautiously when explaining definition and concepts.
Emphasis must be placed on MEMORISING DEFINITIONS. Educators can give small quizzes in class or small tests so that the candidate can familiarise themselves with the correct wording of the definitions as stated in the Examination Guidelines ONLY.
Teachers should stay away from "NONSPECIFIC" terms like "speed" and "faster".
Teachers to revise factors affecting rates using different practical examples in their explanation.
Old examination papers should be used so that candidates can get enough exposure in stoichiometric calculations. A candidate needs to understand how to apply his knowledge of quantitative aspects of chemical change to any other topic in the grade 12 CAPS syllabus.
Examination Guidelines and the Chief Markers Report should be used daily in lesson planning.
Encourage candidates to use Examination Guidelines to study their definitions.
You-tube videos and Phet simulations can also be used to make teaching and learning more interactive and interesting.
Teach lessons that molar volume equation is only used for GASES at STP.
When doing rates, have exercises that address stoichiometric calculations on rates of reaction.
For HYPOTHESIS testing start with investigations and assessment of investigations in earlier grades to assist learners with concepts like independent/dependent/controlled variables/relationships/investigative questions and hypothesis.
For question 5.6 STOICHIOMETRY MUST BE THOROUGHLY COVERED IN GRADE 11.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
Doing practical work is a key strategy to teach reaction rates and to address hypothesis testing
The scientific method must be taught from grade 8 to grade 12. It must be the foundation in most practicals and experiments that are done in class.
Candidates get confused between single arrow and double arrow reactions. Therefore, the candidates get confused between the theory of reaction rates and that of chemical equilibrium. Single arrow in a reaction implies the reaction will not reach equilibrium instead it will reach completion. Double arrow in a reaction taking place in a closed system implies chemical equilibrium
Candidates must be taught that to calculate a gradient of a straight line they apply the same formula as in Mathematics (analytical geometry $(y_2-y_1)/(x_2-x_1)$ – the only difference is that the y will be what is plotted on the vertical axes and the x will be the quantity plotted on the horizontal axis.
This question is based on rate of reactions, a candidate, when explaining a factor by making use of the collision theory have to mention "per unit time" when referring to the effective collisions.
Candidates must be made aware on how marks are awarded for a calculation in Physical Sciences: • Formula (Correctly written or copied from the information sheet) • Substitution • Answer and SI-unit Educators must emphasise in class: FORMULA WITHOUT SUBSTITUTION NO MARK AND "NO UNIT, NO MARK!".

QUESTION 6
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
The average score for this question was **34 %.** Candidates' performance in this question was POOR. Subquestion 6.2 scored the highest at 68% while subquestion 6.4 showed the lowest performance at 26%.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
6.1 The meaning of the term "reversible reaction" was confused with the definition for chemical equilibrium. Some candidates wrote "Reaction that can be reversed"-there is no mark for this as this is in the question

6.3 Many candidates did not explain their answer by making use of Le Chatelier's Principle; instead they stated the principle. Emphasise to learners that when asked to explain using Le Chatelier's Principle they need to write down the following • Change that is opposed, for example, Increase in pressure is opposed • Rule for the changing factor (here it is Increase in pressure) Increase in pressure favours reaction that produces less gas moles • Which reaction is favoured FORWARD or REVERSE? Reverse reaction is favoured
6.4 In this question there were incomplete explanations. Most candidates could identify the reaction as an endothermic reaction, but they did not use Le Chatelier's Principle correctly to explain their answer. Many candidates also did not go back to the beginning of the question and compare the two Kc values with the two different temperatures, to conclude that if the temperature decrease, Kc will decrease, and the reverse exothermic reaction would be favoured.
6.5 Candidates had to start this calculation with the Kc expression and from there work the table from bottom to top. Many candidates started with the table and were confused on how to complete the table to get an unknown mole/ mass. Candidates also got confused between the I_2 and the 2I, especially when writing the Kc expression and substituting the concentration for I. Candidates also did not know the difference between Iodine molecules and Iodine atoms. It is advisable that learners follow this simple method when dealing with Kc calculations: • Write down the Kc expression. • Substitute into Kc expression (and solve for an unknown if possible). • Change mass to moles and change concentration. • Draw and complete a table. • Go back to the Kc expression to work out an unknown (if there is a need).

(c) Provide suggestions for improvement in relation to Teaching and Learning.
Each learner should be provided with an Examination Guideline that must be used in the classroom and for studying.
More focus on the different factors and how they impact on a reaction in equilibrium.
More examples from past year papers.
Teachers must be careful using their "own words in definitions"-use exclusively what comes from exam guidelines.
In question 6.4.1, teachers should start with basics on Kc calculations like writing Kc expressions, substituting equilibrium concentrations into the expression etc. before introducing learners to the table as strategy to solve Kc problems
Develop exercises on writing down the expression for the equilibrium constant for different equilibrium reactions - 8 at least.
Teachers MUST ASSIST learners with explanations for example for explanations you need to: (1) State what change is opposed (2) Rule (concentration/ temperature/ pressure) (3) Which reaction is favoured - reverse reaction OR forward reaction. Learners do not need to re-state Le Chatelier's principle.
Develop exercises on effect of temperature on Kc. Remember Kc changes the same way products change that is if amount of products increase Kc also increases

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
Teachers must use wording cautiously when explaining definition and concepts. EMPHASIS MUST BE PLACED ON MEMORISING DEFINITIONS.
Learners must follow a set of steps in Kc calculations before drawing the table.
When explaining using Le Chatelier, learners do not need to re-state the principle. They indicate the change that is opposed, state the rule (for concentration/ temperature/ pressure) and then write down which reaction is favoured forward or reverse. Many learners, some from well performing centers, restate the rinciple and there are no marks for that.

QUESTION 7
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
The average score for this question was **30%**. Candidates' performance in this question was POOR. Subquestion 7.1 scored the highest at 41% while subquestion 7.2 showed the lowest performance at 21%.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
7.1.1Most candidates could identify ethanoic acid as a weak acid, but they struggled to give a reason for their answer. Most candidates stated that it is a household acid and safe for human consumption instead of stating that ethanoic acid ionises partially/ incompletely in water. It appears that some teachers give learners an incorrect definition of a weak acid "Acid that has a low concentration of hydronium ions". This is not the correct way of defining a weak acid.
7.1.2 Candidates could write the correct formula and substitution for the calculation of [H3O$^+$] from a given pH, but candidates lost marks if they left the answer in the form of $10^{-3,85}$ mol.dm^{-3} instead of writing the answer in decimal form as 1,41 x 10^{-4} mol.dm^{-3}. Candidates also forfeited a mark if they did not write the correct SI unit next to the answer. Some learners wrote the formula as pH = -log [CH_3COOH]-this may have been copied from what the teacher does in class. This way of writing formulae is unacceptable and should be discouraged. Learners need to copy the formula as it is in the formula sheet.
7.1.4 Candidates were very confused when answering this question. Candidates that got the balanced equation for the hydrolysis of sodium ethanoate right, did not explain in words that "because of the formation of the OH^- the solution is basic". Here the candidates looked at the mark allocation and saw that the question counted 3 marks. Generally, a balanced equation is 3 marks, 1 mark for the reactants, 1 mark for the products and 1 mark for balancing. Other candidates would only explain that a "weak acid that redacts with a strong base will form a basic solution", here the candidates forfeited 2 marks for not writing the balanced chemical equation for the hydrolysis of sodium ethanoate.
7.2.1 Candidates could calculate the number of moles from the given information for NaOH, but candidates must show that the ratio between the NaOH and the CH_3COOH is 1:1 and then clearly state that the number of moles for ethanoic acid is equal to the number of moles for NaOH.

7.2.2 Candidates found this question very difficult. First, the candidates did not calculate the mass of the CH_3COOH as a percentage of the volume. This made it difficult for the candidates to calculate the initial number of moles of CH_3COOH. In the next step candidates had to calculate the reacted number of moles of CH_3COOH. Most of the candidates did not do the above-mentioned calculations and got the basic marks for the formula n=m/M, and the substitution of the molar mass of CH_3COOH, the got a mark for the use of the ratio between CH_3COOH and $CaCO_3$, and the last mark was awarded for the use of the molar mass of $CaCO_3$. Many candidates still struggle to do a normal percentage calculation and therefore forfeited the last marks given for the percentage of $CaCO_3$.

(c) Provide suggestions for improvement in relation to Teaching and Learning.
Acids and bases must be TAUGHT PROPERLY IN GRADE 11 and enough time must be allocated in grades 11 and 12 so that candidates fully understand the theory and concepts of acids and bases as prescribed in the CAPS syllabus.
Continue in Grade 11 = revision and consolidation plus additional stoichiometry, THEN proper teaching and revision (consolidation) in Grade 12.
The preparation of a standard solution, dilution of substances and titration practicals must be done in class so that candidates can gain a comprehensive understanding of the theory and experiments.
Use Examination Guidelines and CAPS documents for definitions and thorough teaching.
Each learner from grade 10 to 12 should have a copy of the Examination Guidelines which include content coverage, definitions and data sheets needed.
Candidates should know how to use the formula sheet. This should be introduced from Grade 10 and not just be given in the examination. Each learner must have his/her own copy of the formula sheet in their books so that they can get used to it.
Candidates must be made aware on how marks are awarded for a calculation in Physical Sciences: • Formula (Correctly written or copied from the information sheet) • Substitution • Answer and SI-unit Educators must emphasise in class: “NO UNIT, NO MARK!”.

FOR STOICHIOMETRIC CALCULATIONS LEARNERS MUST BE TAUGHT ONE METHOD THAT ALWAYS WORKS IN EVERY SITUATION. For example, why must learners when dealing with acids and bases in grade 12 find a new formula for titration caV/cb.Vb = na/nb? To learners this is totally new, and they throw away all that has been taught earlier on stoichiometry and yet things work the same way – there is no need for a new formula. Learners need to read the question and apply n= cV and use ratios and calculate the unknown. The association of the ca.Va/cb.Vb = na/nb with acids and bases limits learners' thinking – immediately they see a calculation involving acids and bases they plug in that formula even if it does not apply – very unfortunate.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
Teachers must use wording cautiously when explaining definition and concepts. EMPHASIS MUST BE PLACED ON MEMORISING DEFINITIONS.
Candidates must be told to revise and practise quantitative aspects of chemical change and stoichiometric calculations from grades 10 and 11, and they must also practise how to convert units into SI-units. Additional attention must be given to this when teaching acids and bases.
Use Examination Guidelines and CAPS document when teaching.
The questions in the textbooks only test basic applications, but not in-depth calculations.
Past question papers MUST be consulted to guide the candidates. DO NOT just hand out question paper and memo.
Familiarise yourself and your learners with the formula sheet. Learners lose too many marks for using/writing incorrect formulae.
Teachers must refrain from using the formula pH + pOH = 14. This formula confuses the learners in calculating the concentration of the hydronium ion. Focus on the following two formulae: $pH = -log[H_3O^+]$ and $[H_3O^+] = 10^{-pH}$

QUESTION 8
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
The average score for this question was **37%.** Candidates' performance in this question was POOR. Subquestion 8.5 scored the highest at 57% while subquestion 8.6 showed the lowest performance at %.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
8.1 A common error candidates made in writing the function of the salt bridge, is stating that the salt bridge completes the cell or that the salt bridge is a pathway for the electrons to move. Candidates also refer to the salt bridge as maintaining neutrality of the electrons.
8.2 Candidates referred to the electrode as if it is the substance that are being oxidised. The correct answer for the definition of an anode is "the electrode WHERE oxidation takes place/ WHERE electrons are lost.
8.4.1 Candidates still make use of the double arrow when writing half reactions from the Table of Standard Reduction potentials.
8.5 Candidates failed to know that magnesium was the anode and hydrogen as the cathode in this galvanic cell. There are still candidates who write Ecell = Ecat – Ean or Ecell = Ered - Eox. Teachers need to know that this is not acceptable.
8.6 This question was challenging for most of the learners. The question states that Mg/Mg^{2+} half-cell was replaced by a Cu/Cu^{2+} half-cell. The candidates then forgot about the hydrogen half-cell and explained the question in terms of Mg/Mg^{2+} and Cu/Cu^{2+}. The candidates had to use the Table of Standard Reduction Potentials to see that H_2 is a stronger reducing agent than the Cu and therefore the Cu^{2+}/Cu ions are reduced or H_2 is oxidised.

(c) Provide suggestions for improvement in relation to Teaching and Learning.
Educators should emphasise to candidates that they should NOT be using double arrows when writing redox half reactions.
Giving REASONS why a substance is an oxidising or reducing agent should be taught properly by educators. Candidates do not understand the table of reduction potentials and they do not know that there is a difference between an atom and an ion in terms of oxidising and reducing abilities.

DEFINITIONS OF THE TERMS reducing agent, oxidation, oxidising agent and reduction must not just be memorised but also understood by the candidates, as the understanding of these definitions are very important in the application thereof.
The table of standard reduction potentials must be taught well at school level and must also be INTRODUCED IN GRADE 11 already and not just referred to by the educator when explaining electrolytic cells, so that learners can understand, interpret and use the table.
Definitions should be studied from the Examination Guidelines. Each learner must be provided with a copy of the Examination Guidelines.
Teachers must avoid using abbreviations when writing formulae. They must write formula the same way they are written in the formula sheet.
Develop exercises that integrate topics in chemical change e.g., Le Chatelier's principle with galvanic cells or acids and bases.
Use demonstrations when teaching electrochemistry.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
Teachers must use wording cautiously when explaining definition and concepts. EMPHASIS MUST BE PLACED ON MEMORISING DEFINITIONS.
Rather avoid using the words oxidized and reduced as you are adding more confusing vocabulary – limit the vocabulary to oxidation, reduction, reducing agent and oxidising agents.
Learners must group oxidation/ reducing agent/ anode together in their thinking as these are all related.
Subject advisors need to find out if teachers are consulting CAPS document and exam guidelines when preparing for lessons. Some learner responses indicate that some of the incorrect responses were taught in class. For example, the whole center would write "The salt bridge connects the two half cells"

QUESTION 9
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
The average score for this question was **31 %.** Candidates' performance in this question was VERY LOW. Subquestion 9.2 scored the highest at 60% while subquestion 9.4 showed the lowest performance at 11%.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
9.1 Many candidates could give the definition of electrolysis, but some candidates wrote that "electrical energy is converted to mechanical energy" and some even defined an electrolyte.
9.3 Candidates could not recall knowledge from grade 10 concerning the solubility rules where the silver ions must be free to move in the electrolyte for electroplating to take place. Most of the solutions given by the learners were insoluble, e.g., AgCℓ.
9.4 Candidates struggle to link chemical equilibrium with electrochemistry. So many candidates could not answer this question by saying that the rate of oxidation is equal to the rate of reduction. A common error made by the candidates was that for every ion formed an ion is used. The integration of Le Chatelier's principle into galvanic cell questions was foreign to most candidates.
9.5 Candidates still make use of the double arrow when writing half reactions from the Table of Standard Reduction potentials.

(c) Provide suggestions for improvement in relation to Teaching and Learning.
Educators should emphasise to candidates that they should not be using double arrows when writing redox half reactions.
Giving reasons why a substance is an oxidising or reducing agent should be taught properly by educators. Candidates do not understand the table of reduction potentials and they do not know that there is a difference between an atom and an ion in terms of oxidising and reducing abilities.
Definitions of the terms reducing agent, oxidation, oxidising agent and reduction must not just be memorised but also understood by the candidates, as the understanding of these definitions is very important in the application thereof.

Teachers must teach the reduction potential tables properly. Teachers should try and complete the chapter on fertilisers earlier. Leaners must study all the processes and the preparation of ammonium nitrate and ammonium sulfate. Leaners must be given opportunities to answer different examples of the fertiliser calculations. Educators must always ensure to have revision done before exams.
During lesson preparation, planning and demonstration, teachers must use the policy documents, CAPS, Examination guidelines and Chief Marker's reports.
More informal assessments should be done with regular feedback to learners to avoid these misconceptions and to expose them in different questioning styles.
Teacher must make it a point to use examination guidelines when teaching definitions and make copies available for learners. Teachers must revise solubility rules, valency and writing chemical formulae from grade 10. Teachers must also use different teaching modes of teaching to get concepts across, especially the videos and simulation.
Using a demonstration to deal with the basic electrolytic cell (using $CuCl_2$) as the electrolyte to introduce the concepts of anode ,cathode, migration of ions, half reactions and comparing strengths of oxidising agents (e.g. H_2O and Cu^{2+} or H_2O and Na^+). Learners need to know that the negative substance(Cl^- in this case) (second part in the formula) always migrates to the anode to undergo oxidation (therefore a reducing agent).The first part in the formula has to be compared with water in terms of oxidising abilities. If water is the stronger oxidising agent, then H_2O will undergo reduction. Or if the substance is a stronger oxidising agent (like Cu^{2+}) then that substance will undergo reduction)
Group electrolytic cell into two based on their type of electrodes: UNREACTIVE Electrodes (Carbon rods where the electrolyte is either $CuCl_2$, NaCl or Aluminium oxide in cryolite) AND REACTIVE electrodes that is electroplating and electro refining.
Discuss each using a demonstration where possible. Compare and contrast the cells.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
Teachers must use wording cautiously when explaining definition and concepts. EMPHASIS MUST BE PLACED ON MEMORISING DEFINITIONS.
Subject advisors should ensure that all teachers for the subject have exam guidelines and policy documents and use them effectively.
Informal assessments must include all cognitive levels and should be done on a regular basis (SMT to monitor that).
Syllabus must be tracked, just to make sure that all topics are taught within the stipulated time and intense revision is done.'

COMMON MEMO DISCUSSIONS for each formal assessment should be done by teachers at district level together with the district subject advisors.
Teachers must be facilitated by the subject advisors.
Team and PEER TEACHING and preparation are recommended in order to SHARE KNOWLEDGE. Teachers must diversify their teaching material, not relying on one prescribed textbook.
The topic on electrolysis is done in term 3 – a very busy time for teachers. The suspicion is that little time is spent on the topic and there are few exercises to reinforce the concepts on electrolysis. Considering that there are five electrolytic cells to be studied at grade 12 and only 8 to 12 marks in the paper some teachers may be ignoring teaching this topic altogether.
Misconception amongst learners is that if a substance cannot be reduced then it is a strong reducing agent in this case Na^+.
The table of reduction potentials is not understood by learners: which substances are reducing agents and which substances are oxidising agent and what are the trends in terms of strengths of the agents.

QUESTION 10
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
The average score for this question was **34 %.** Candidates' performance in this question was POOR. Subquestion 10.1 scored the highest at 35% while subquestion 10.2 showed the lowest performance at 31%.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
10.2.1 Many candidates wrote that the ratio represents the percentage of NPK.
10.2.2 Candidates struggled to obtain full marks for this calculation. Many candidates could do the 4/9 but struggled to calculate X as a percentage of the mass of the bag.

(c) Provide suggestions for improvement in relation to Teaching and Learning.
REGULAR USE of standard reduction potential table should be highlighted, and each candidate must have a copy of it as to familiarise themselves with it. Educators should have a memorandum for the past question papers to know exactly what is expected because most candidates' misconceptions come from educators' teaching methods and shorthand writing.
Educators should make time (manage time) in teaching these topics (fertilisers and electrochemistry) to have more time to revise with their candidates and make them write to eliminate wrong spelling and wrong chemical formulae.

Last topics should be given more attention since there is less time to teach and revise them.
Candidates and educators must be encouraged to take definitions from the Examination Guidelines. Educators must make it a point to use Examination Guidelines when teaching definitions and make copies available for learners. Educators must revise solubility rules, valency and writing chemical formulae from grade 10. Educators must teach the reduction potential tables properly. Teachers should try and complete the chapter on fertilisers earlier. Learners must study all the processes and the preparation of ammonium nitrate and ammonium sulfate. Learners must be given opportunities to answer different examples of the fertiliser calculations. Educators must always ensure to have revision done before exams.
Find time do fertilisers early in the year, term 1 preferably. Have charts for the industrial processes on classroom walls. Administer short tests on flow diagrams on a monthly basis throughout the first term.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
More revision should be done with candidates with different question styles and to boost their level of confidence to the calculations bases on the fertiliser bag.
Teachers should stick to the marking guidelines and stop giving learners marks they do not deserve e.g., if a unit is omitted, learners are awarded marks.
In each type of assessment, definitions must be included and a formula sheet must be given to learners. They should be encouraged to use/take formulae as they are from the formula sheet.
Teachers must diversify their teaching material, not relying on one prescribed textbook. They should also try to get or download videos to explain difficult concepts.
Chemical formulae are a challenge to learners – this is content that should have been taught in earlier grades and will be required in institutions of higher learning.
In CAPS there are only TWO equations for the preparation of fertilisers and every year ONE of them is asked. There is no reason why candidates should not get the marks for this question.
Practise naming of compounds in the industrial processes.

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE/ NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY (P2)

NOVEMBER 2020

MARKS: 150

TIME: 3 hours

This question paper consists of 15 pages and 4 data sheets.

* P H S C E 2 *

INSTRUCTIONS AND INFORMATION

1. Write your examination number and centre number in the appropriate spaces on the ANSWER BOOK.

2. This question paper consists of TEN 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. 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 is the general formula for the alkanes?

A C_nH_{2n}

B C_nH_{2n-2}

C C_nH_{2n+2}

D $C_nH_{2n+2}O$ (2)

1.2 The EMPIRICAL FORMULA of hexanoic acid is …

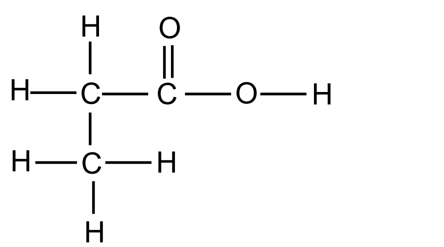
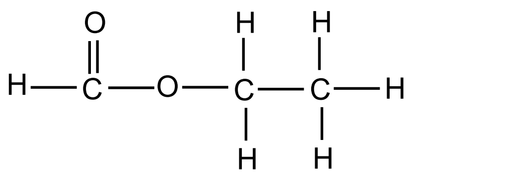
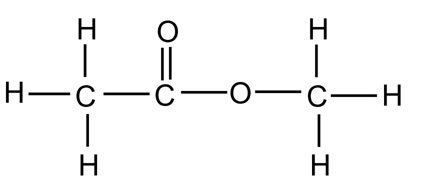
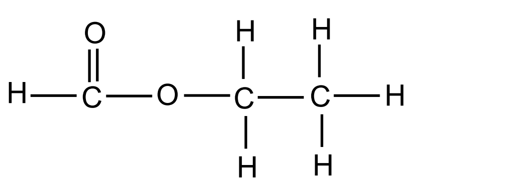
A $C_3H_6O_2$

B $C_6H_6O_2$

C $C_6H_{12}O_2$

D C_3H_6O (2)

1.3 Which ONE of the following is the CORRECT structural formula for METHYL ETHANOATE?

A		**B**	
C		**D**	

(2)

1.4 Zinc (Zn) granules react as follows with EXCESS hydrochloric acid solution, HCℓ(aq):

$$Zn(s) + HCℓ(aq) \rightarrow ZnCℓ_2(aq) + H_2(g)$$

Which ONE of the following combinations of volume and concentration of HCℓ(aq) will result in the highest INITIAL reaction rate for the same mass of zinc granules used? (Assume that the zinc granules are completely covered by the acid in all cases.)

	VOLUME HCℓ(aq) (cm^3)	**CONCENTRATION HCℓ(aq) ($mol{\cdot}dm^{-3}$)**
A	50	0,5
B	100	1,0
C	200	0,1
D	200	0,5

(2)

1.5 The role of a catalyst in a chemical reaction is to increase the …

A yield.

B activation energy.

C heat of reaction.

D rate of the reaction. (2)

1.6 Consider the equilibrium represented by the balanced equation below:

$$2CrO_4^{2-}(aq) + 2H^+(aq) \rightleftharpoons Cr_2O_7^{2-}(aq) + H_2O(ℓ) \quad \Delta H < 0$$

Which ONE of the following changes to the equilibrium will favour the forward reaction?

	TEMPERATURE	**pH**
A	Decrease	Increase
B	Decrease	Decrease
C	Increase	Increase
D	Increase	Decrease

(2)

1.7 The conjugate base of HPO_4^{2-} is …

A OH^-

B PO_4^{3-}

C $H_2PO_4^-$

D H_3PO_4 (2)

1.8 Which ONE of the following reactions will proceed spontaneously under standard conditions?

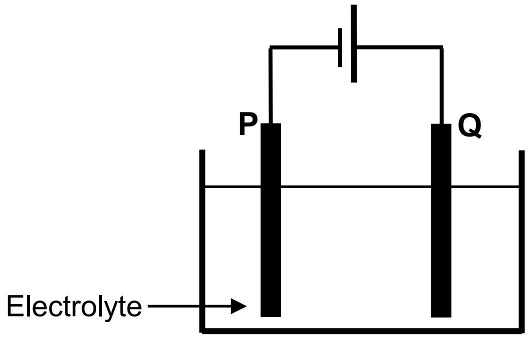
A $Ni^{2+}(aq) + H_2(g) \rightarrow Ni(s) + 2H^+(aq)$

B $Br_2(\ell) + 2C\ell^-(aq) \rightarrow 2Br^-(aq) + C\ell_2(g)$

C $2Fe^{3+}(aq) + 2I^-(aq) \rightarrow 2Fe^{2+}(aq) + I_2(s)$

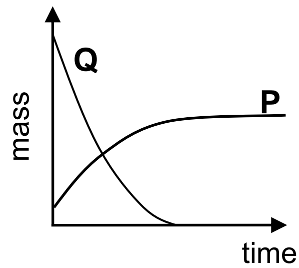
D $2Cu^+(aq) + Pb^{2+}(aq) \rightarrow 2Cu^{2+}(aq) + Pb(s)$ (2)

1.9 The simplified diagram below represents an electrochemical cell used for the PURIFICATION of copper.

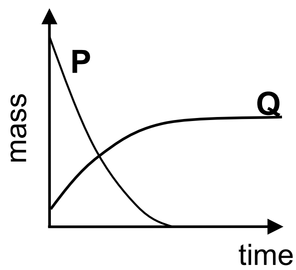


Which ONE of the graphs below represents the CHANGE IN MASS of electrodes **P** and **Q** during the purification process?

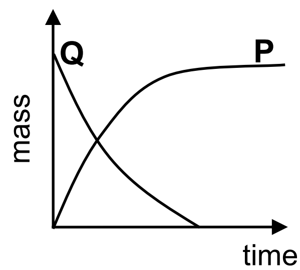
A



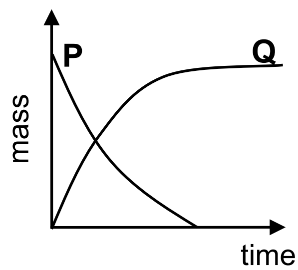
B



C



D



(2)

1.10 Eutrophication in water is caused by …

A algal bloom.

B bacterial nitrogen fixation.

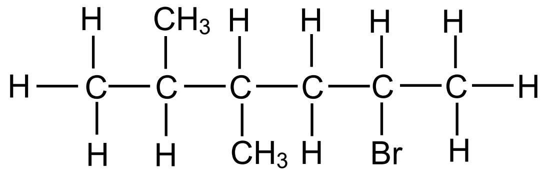
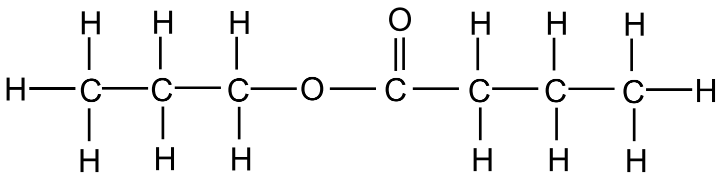
C an increase in plant nutrients.

D a depletion of oxygen concentration. (2)

[20]

QUESTION 2 (Start on a new page.)

The letters **A** to **E** in the table below represent five organic compounds.

A		**B**	C_3H_8O
C		**D**	Pentan-2-one
E	4-methylpent-2-yne		

Use the information in the table to answer the questions that follow.

2.1 For compound **D**, write down the:

2.1.1 Homologous series to which it belongs (1)

2.1.2 IUPAC name of a FUNCTIONAL ISOMER (2)

2.2 Write down the:

2.2.1 IUPAC name of compound **A** (3)

2.2.2 STRUCTURAL FORMULA of compound **E** (2)

2.3 Compound **B** is a primary alcohol.

2.3.1 Write down the meaning of the term *primary alcohol*. (2)

Compound **B** reacts with another organic compound **X** to form compound **C**.

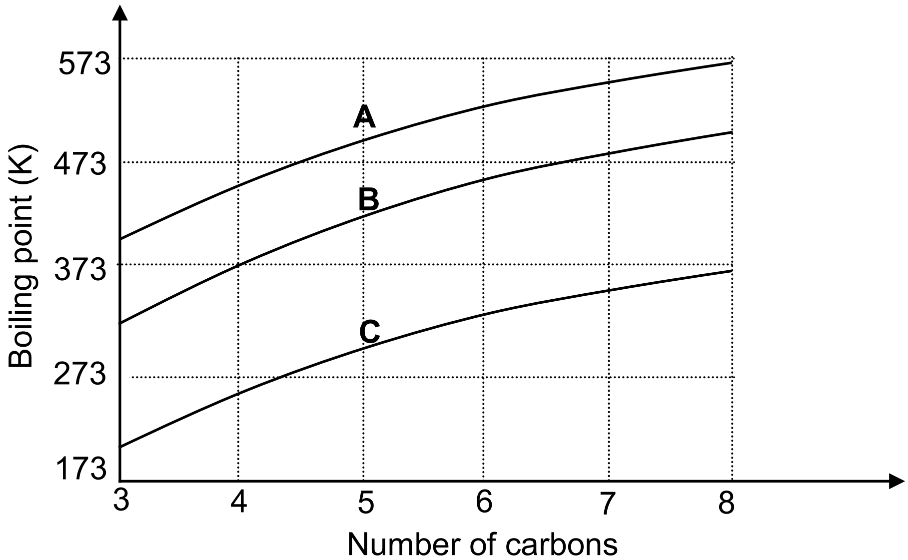
Write down the:

2.3.2 Type of reaction that takes place (1)

2.3.3 IUPAC name of compound **X** (1)
[12]

QUESTION 3 (Start on a new page.)

The relationship between boiling point and the number of carbon atoms in straight chain molecules of aldehydes, alkanes and primary alcohols is investigated. Curves **A**, **B** and **C** are obtained.



3.1 Define the term *boiling point*. (2)

3.2 Write down the STRUCTURAL FORMULA of the functional group of the aldehydes. (1)

3.3 The graph shows that the boiling points increase as the number of carbon atoms increases. Fully explain this trend. (3)

3.4 Identify the curve (**A**, **B** or **C**) that represents the following:

3.4.1 Compounds with London forces only (1)

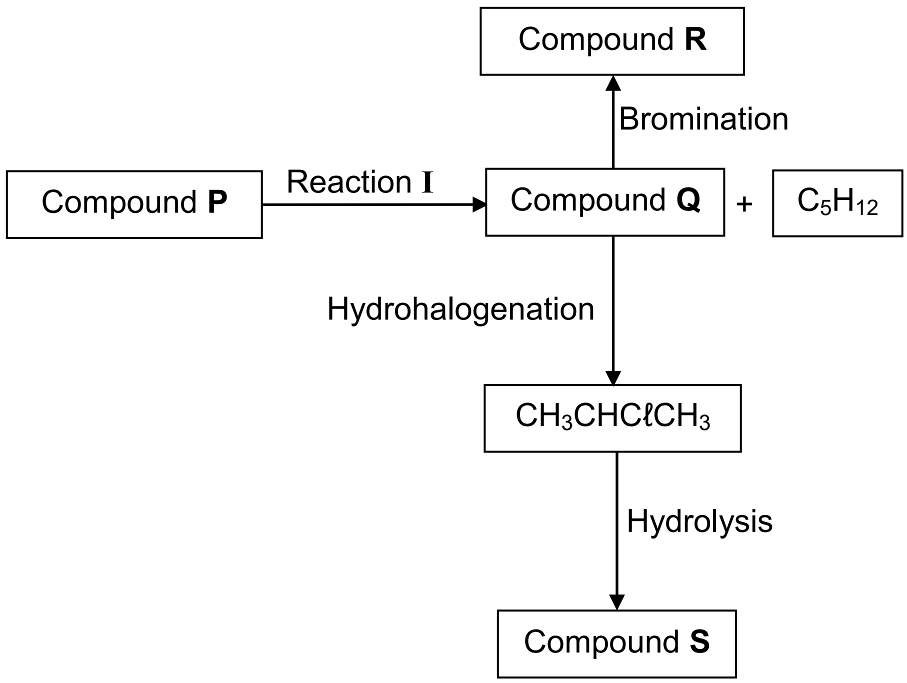
3.4.2 The aldehydes
Explain the answer. (4)

3.5 Use the information in the graph and write down the IUPAC name of the compound with a boiling point of 373 K. (2)

3.6 Write down the IUPAC name of the compound containing five carbon atoms, which has the lowest vapour pressure at a given temperature. (2)
[15]

QUESTION 4 (Start on a new page.)

The flow diagram below shows how various organic compounds can be prepared using compound **P** as starting reagent.



4.1 Write down the meaning of the term *hydrohalogenation*. (2)

4.2 Write down the STRUCTURAL FORMULA of compound **Q**. (2)

4.3 **Reaction I** is an elimination reaction.

Write down the:

4.3.1 TYPE of elimination reaction (1)

4.3.2 MOLECULAR FORMULA of compound **P** (1)

4.4 Write down the IUPAC name of compound **R**. (2)

4.5 For the HYDROLYSIS REACTION, write down the:

4.5.1 Balanced equation using structural formulae (5)

4.5.2 TWO reaction conditions (2)

[15]

QUESTION 5 (Start on a new page.)

The reaction of calcium carbonate ($CaCO_3$) and EXCESS dilute hydrochloric acid ($HC\ell$) is used to investigate one of the factors that affects reaction rate. The balanced equation for the reaction is:

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

The same mass of $CaCO_3$ is used in all the experiments and the temperature of the hydrochloric acid in all experiments is 40 °C.

The reaction conditions for each experiment are summarised in the table below.

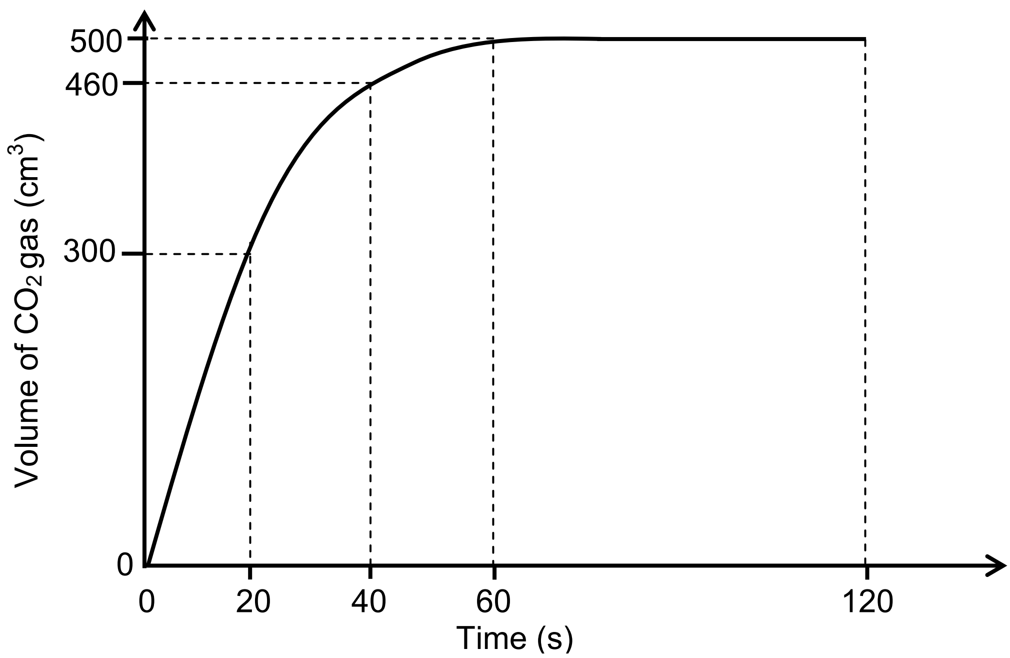
EXPERIMENT	**VOLUME OF $HC\ell(aq)$ (cm^3)**	**CONCENTRATION OF $HC\ell(aq)$ ($mol\cdot dm^{-3}$)**	**STATE OF DIVISION OF $CaCO_3$**
A	500	0,1	granules
B	500	0,1	lumps
C	500	0,1	powder

5.1 For this investigation write down the:

5.1.1 Dependent variable (1)

5.1.2 Independent variable (1)

The carbon dioxide gas, $CO_2(g)$, produced during EXPERIMENT **A**, is collected in a gas syringe. The volume of gas collected is measured every 20 s and the results obtained are shown in the graph below.



5.2 What can be deduced from the graph regarding the RATE OF THE REACTION during the time interval:

5.2.1 20 s to 40 s (1)

5.2.2 60 s to 120 s (1)

5.3 Calculate the average rate (in $cm^3 \cdot s^{-1}$) at which $CO_2(g)$ is produced in the experiment. (3)

5.4 How will the volume of $CO_2(g)$ produced in experiment **B** compare to that produced in experiment **A**? Choose from GREATER THAN, SMALLER THAN or EQUAL TO. (1)

5.5 A graph is now drawn for experiment **C** on the same set of axes. How will the gradient of this graph compare to the gradient of the graph for experiment **A**? Choose from GREATER THAN, SMALLER THAN or EQUAL TO.

Use the collision theory to fully explain the answer. (4)

5.6 Assume that the molar gas volume at 40 °C is 25,7 $dm^3 \cdot mol^{-1}$. Calculate the mass of $CaCO_3(s)$ used in experiment **A**. (4)
[16]

QUESTION 6 (Start on a new page.)

The dissociation of iodine molecules to iodine atoms (I) is a reversible reaction taking place in a sealed container at 727 °C. The balanced equation for the reaction is:

$$I_2(g) \rightleftharpoons 2I(g)$$

K_c for the reaction at 727 °C is 3,76 x 10^{-3}.

6.1 Write down the meaning of the term *reversible reaction*. (1)

6.2 At equilibrium the pressure of the system is increased by decreasing the volume of the container at constant temperature.

How will EACH of the following be affected? Choose from INCREASES, DECREASES or REMAINS THE SAME.

6.2.1 The value of the equilibrium constant (1)

6.2.2 The number of I_2 molecules (1)

6.3 Explain the answer to QUESTION 6.2.2 by referring to Le Chatelier's principle. (2)

6.4 At 227 °C, the K_C value for the reaction above is 5,6 x 10^{-12}.

Is the forward reaction ENDOTHERMIC or EXOTHERMIC?
Fully explain the answer. (4)

6.5 A certain mass of iodine molecules (I_2) is sealed in a 12,3 dm^3 flask at a temperature of 727 °C (K_c = 3,76 x 10^{-3}).

When equilibrium is reached, the concentration of the iodine atoms is found to be 4,79 x 10^{-3} $mol{\cdot}dm^{-3}$. Calculate the INITIAL MASS of the iodine molecules in the flask. (9)

[18]

QUESTION 7 (Start on a new page.)

7.1 Ethanoic acid (CH_3COOH) is an ingredient of household vinegar.

7.1.1 Is ethanoic acid a WEAK acid or a STRONG acid? Give a reason for the answer. (2)

7.1.2 An ethanoic acid solution has a pH of 3,85 at 25 °C. Calculate the concentration of the hydronium ions, $H_3O^+(aq)$, in the solution. (3)

Sodium ethanoate, $CH_3COONa(aq)$, forms when ethanoic acid reacts with sodium hydroxide.

7.1.3 Will the pH of a sodium ethanoate solution be GREATER THAN 7, LESS THAN 7 or EQUAL TO 7? (1)

7.1.4 Explain the answer to QUESTION 7.1.3 with the aid of a balanced chemical equation. (3)

7.2 Household vinegar contains 4,52% ethanoic acid, CH_3COOH by volume.

A 1,2 g impure sample of calcium carbonate ($CaCO_3$) is added to 25 cm^3 household vinegar.

On completion of the reaction, the EXCESS ethanoic acid in the household vinegar is neutralised by 14,5 cm^3 of a sodium hydroxide solution of concentration 1 $mol{\cdot}dm^{-3}$. The balanced equation for the reaction is:

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

7.2.1 Calculate the number of moles of the unreacted ethanoic acid. (3)

7.2.2 Calcium carbonate reacts with ethanoic acid according to the following balanced equation:

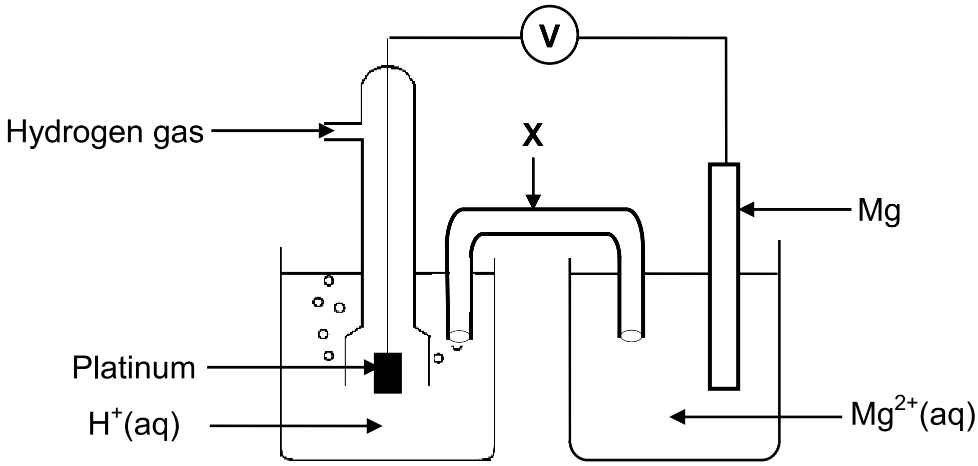
$$CaCO_3(s) + 2CH_3COOH(aq) \rightarrow (CH_3COO)_2Ca(aq) + H_2O + CO_2(g)$$

Calculate the percentage calcium carbonate in the impure sample if 1 cm^3 of household vinegar has a mass of 1 g. (8)

[20]

QUESTION 8 (Start on a new page.)

The electrochemical cell illustrated below is set up under standard conditions.



8.1 Component **X** completes the circuit in the cell. State ONE other function of component **X**. (1)

8.2 Define the term *anode*. (2)

8.3 Identify the anode in the cell above. (1)

8.4 Write down the:

8.4.1 Reduction half-reaction that takes place in this cell (2)

8.4.2 NAME or FORMULA of the reducing agent in this cell (1)

8.5 Calculate the initial voltmeter reading of this cell under standard conditions. (4)

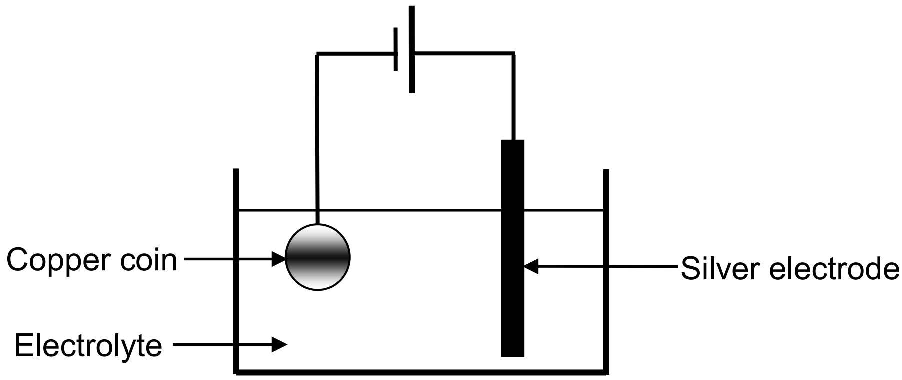
8.6 The $Mg|Mg^{2+}$ half-cell is now replaced by a $Cu|Cu^{2+}$ half-cell. It is found that the direction of electron flow changes.

Fully explain why there is a change in direction of electron flow by referring to the relative strengths of the reducing agents involved. (3)

[14]

QUESTION 9 (Start on a new page.)

The simplified diagram below represents an electrolytic cell used to electroplate a copper (Cu) coin with silver (Ag).



9.1 Define the term *electrolysis*. (2)

9.2 Which component in the diagram indicates that this is an electrolytic cell? (1)

9.3 Write down the NAME or FORMULA of the electrolyte. (1)

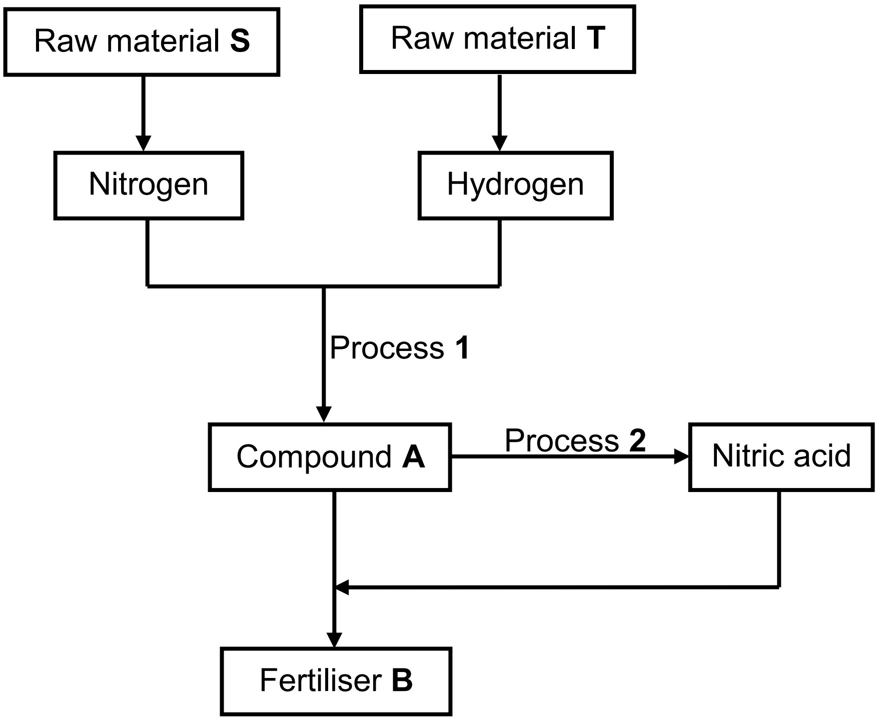
9.4 How will the concentration of the electrolyte change during electroplating? Choose from INCREASES, DECREASES or REMAINS THE SAME.

Give a reason for the answer. (2)

9.5 Write down the balanced equation of the half-reaction that takes place at the silver electrode. (2)
[8]

QUESTION 10 (Start on a new page.)

10.1 The flow diagram below shows how fertiliser **B** is produced in industry.



Write down the:

10.1.1 NAME of **S** (1)

10.1.2 NAME of **T** (1)

10.1.3 NAME or FORMULA of the catalyst used in process **1** (1)

10.1.4 NAME or FORMULA of compound **A** (1)

10.1.5 NAME of process **2** (1)

10.1.6 Balanced equation for the formation of fertiliser **B** (3)

10.2 A 20 kg bag of fertiliser is labelled as follows: **2 : 4 : 3 (X)**.

10.2.1 What does the ratio on the label represent? (1)

10.2.2 The bag contains 2,315 kg phosphorous.

Calculate the value of **X**. (3)
[12]

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* $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^{+}]$
$K_w = [H_3O^{+}][OH^{-}] = 1 \times 10^{-14}$ 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* $E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent} / E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$	

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE

KEY/*SLEUTEL*

Electronegativity / *Elektronegatiwiteit*	Atomic number / *Atoomgetal*	Symbol / *Simbool*	Approximate relative atomic mass / *Benaderde relatiewe atoommassa*
1,9	29	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 oxidising ability/*Toenemende oksiderende vermoë* ↑

Increasing reducing ability/*Toenemende reduserende vermoë* ↓

Half-reactions/*Halfreaksies*			E^{θ} (V)
$F_2(g) + 2e^-$	⇌	$2F^-$	+ 2,87
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81
$H_2O_2 + 2H^+ + 2e^-$	⇌	$2H_2O$	+1,77
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+ 1,51
$C\ell_2(g) + 2e^-$	⇌	$2C\ell^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 1,33
$O_2(g) + 4H^+ + 4e^-$	⇌	$2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+ 1,23
$Pt^{2+} + 2e^-$	⇌	Pt	+ 1,20
$Br_2(\ell) + 2e^-$	⇌	$2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^-$	⇌	$Hg(\ell)$	+ 0,85
$Ag^+ + e^-$	⇌	Ag	+ 0,80
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+ 0,80
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+ 0,77
$O_2(g) + 2H^+ + 2e^-$	⇌	H_2O_2	+ 0,68
$I_2 + 2e^-$	⇌	$2I^-$	+ 0,54
$Cu^+ + e^-$	⇌	Cu	+ 0,52
$SO_2 + 4H^+ + 4e^-$	⇌	$S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^-$	⇌	$4OH^-$	+ 0,40
$Cu^{2+} + 2e^-$	⇌	Cu	+ 0,34
$SO_4^{2-} + 4H^+ + 2e^-$	⇌	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + e^-$	⇌	Cu^+	+ 0,16
$Sn^{4+} + 2e^-$	⇌	Sn^{2+}	+ 0,15
$S + 2H^+ + 2e^-$	⇌	$H_2S(g)$	+ 0,14
$2H^+ + 2e^-$	**⇌**	**$H_2(g)$**	**0,00**
$Fe^{3+} + 3e^-$	⇌	Fe	− 0,06
$Pb^{2+} + 2e^-$	⇌	Pb	− 0,13
$Sn^{2+} + 2e^-$	⇌	Sn	− 0,14
$Ni^{2+} + 2e^-$	⇌	Ni	− 0,27
$Co^{2+} + 2e^-$	⇌	Co	− 0,28
$Cd^{2+} + 2e^-$	⇌	Cd	− 0,40
$Cr^{3+} + e^-$	⇌	Cr^{2+}	− 0,41
$Fe^{2+} + 2e^-$	⇌	Fe	− 0,44
$Cr^{3+} + 3e^-$	⇌	Cr	− 0,74
$Zn^{2+} + 2e^-$	⇌	Zn	− 0,76
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	− 0,83
$Cr^{2+} + 2e^-$	⇌	Cr	− 0,91
$Mn^{2+} + 2e^-$	⇌	Mn	− 1,18
$A\ell^{3+} + 3e^-$	⇌	$A\ell$	− 1,66
$Mg^{2+} + 2e^-$	⇌	Mg	− 2,36
$Na^+ + e^-$	⇌	Na	− 2,71
$Ca^{2+} + 2e^-$	⇌	Ca	− 2,87
$Sr^{2+} + 2e^-$	⇌	Sr	− 2,89
$Ba^{2+} + 2e^-$	⇌	Ba	− 2,90
$Cs^+ + e^-$	⇌	Cs	- 2,92
$K^+ + e^-$	⇌	K	− 2,93
$Li^+ + e^-$	⇌	Li	− 3,05

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

Increasing oxidising ability/*Toenemende oksiderende vermoë* (downward)

Increasing reducing ability/*Toenemende reduserende vermoë* (upward)

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

SENIOR CERTIFICATE/*SENIOR SERTIFIKAAT*
NATIONAL SENIOR CERTIFICATE/
NASIONALE SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

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

NOVEMBER 2020

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

DEPARTMENT OF BASIC EDUCATION
PRIVATE BAG X895, PRETORIA 0001
2020 -12- 02
APPROVED MARKING GUIDELINE
PUBLIC EXAMINATION

Approved Umalusi Ext. Mod. 02/12/2020

These marking guidelines consist of 17 pages./
Hierdie nasienriglyne bestaan uit 17 bladsye.

Approved DBE IM 2/12/2020

approved DBE FM 2/12/2020

approved DBE CE 2/12/20

Approved Umalusi Ext. Mod. 2/12/2020

QUESTION 1/*VRAAG 1*

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

QUESTION 2/*VRAAG 2*

2.1.1 Ketones/*Ketone* ✓ (1)

2.1.2 Pentanal/*Pentanaal* ✓✓

ACCEPT/*AANVAAR*
2,2-dimethylpropanal/*2,2-dimethylpropanaal*
2-methylbutanal/*2-metielbutanaal*
3-methylbutanal/*3-metielbutanaal*

Marking criteria/*Nasienriglyne*
- Correct functional group,i.e. – al / *Korrekte funksionele groep d.i. al* ✓
- Whole name correct/*Hele naam korrek*✓

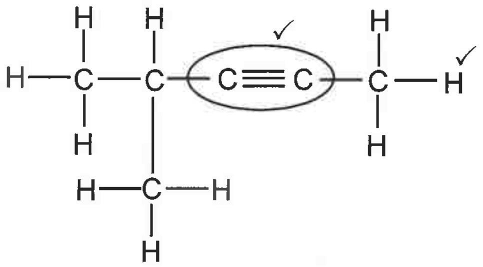
(2)

2.2.1 5 – bromo-2,3 – dimethylhexane/*5 – bromo-2,3 – dimetielheksaan*

Marking criteria/*Nasienriglyne:*
- Correct stem i.e. hexane./*Korrekte stam d.i. heksaan.* ✓
- All substituents (bromo and dimethyl) correctly identified./*Alle substituente (bromo en dimetiel) korrek geïdentifiseer.* ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas./*IUPAC-naam heeltemal korrek insluitende volgorde, koppeltekens en kommas .* ✓

(3)

2.2.2



Marking criteria/*Nasienriglyne*
- Whole structure correct/*Hele struktuur korrek:* $\frac{2}{2}$
- Only functional group correct:/*Slegs funksionele groep korrek:* Max/*Maks.*: $\frac{1}{2}$

IF/*INDIEN*
More than one functional group/*Meer as een funksionele groep* $\frac{0}{2}$

(2)

IF/*INDIEN*
Molecular formula/*Molekulêre formule* $\frac{0}{2}$
Condensed structural formula /*Gekondenseerde struktuurformule* $\frac{1}{2}$

2.3.1 The C atom bonded to the hydroxyl group is bonded to only one other C-atom. ✓✓ **(2 or 0)**
Die C-atoom wat aan die hidroksielgroep gebind is, is aan slegs een ander C-atoom gebind. ***(2 or 0)***

OR/*OF*
The hydroxyl group/-OH/ is bonded to a C atom which is bonded to two hydrogens atoms. **(2 or 0)**
Die hidroksielgroep/funksionele groep is gebind aan 'n C-atoom wat aan twee waterstofatome gebind is. ***(2 of 0)***

OR/*OF*
The hydroxyl group/functional group/-OH is bonded to:
a primary C atom / the first C atom **(2 or 0)**
Die hidroksielgroep/funksionele groep/-OH aan
'n primêre C-atoom gebind / die eerste C-atoom gebind ***(2 of 0)***

OR/*OF*

The functional group (— C - OH) is bonded to only one other C-atom. (the C carries a vertical bond line above and below)

Die funksionele groep (— C – OH) is aan slegs een ander C-atoom gebind. (the C carries a vertical bond line above and below) (2)

2.3.2 Esterification/condensation ✓
Verestering/esterifikasie/kondensasie (1)

2.3.3 Butanoic acid/*Butanoësuur* ✓ (1)
[12]

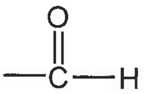
QUESTION 3/*VRAAG 3*

3.1

Marking criteria/*Nasienriglyne*
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.*

The temperature at which the vapour pressure equals atmospheric (external) pressure. ✓✓
Die temperatuur waar die dampdruk gelyk is aan atmosferiese (eksterne) druk. (2)

3.2



✓ (1)

3.3

- Increase in the number of C-atoms increases molecular mass/size/chain length/surface area. ✓
- Strength of the intermolecular forces increases/More sites for London forces. ✓
- More energy is needed to overcome/break intermolecular forces. ✓

- *Toename in aantal C-atome verhoog molekulêre massa/molekulêre grootte/kettinglengte/reaksie-oppervlak.*
- *Sterkte van die intermolekulêre kragte verhoog./Meer punte vir Londonkragte.*
- *Meer energie benodig om intermolekulêre kragte te oorkom/breek.* (3)

3.4.1 C ✓ (1)

3.4.2 B ✓

Marking criteria/*Nasienriglyne*
- Compare strength of intermolecular forces of A, B and C. ✓
- Compare boiling points/energy required to overcome intermolecular forces of alcohols/A and aldehydes/B. ✓
  OR
  Alcohols have the highest boiling point.
- Compare boiling points/ energy required to overcome intermolecular force of aldehydes/B and alkanes/C .✓
  OR
  Alkanes have the lowest boiling point.

- *Vergelyk sterkte van intermolekulêre kragte van A, B en C.* ✓
- *Vergelyk kookpunte /energie benodig om intermolekulêre kragte van alkohole/A en aldehiede/B te oorkom.* ✓
  OF
  Alkohole het die hoogste kookpunt.
- *Vergelyk kookpunte /energie benodig om intermolekulêre kragte van aldehiede/B en alkane/C.* ✓
  OF
  Alkane het die laagste kookpunt.

Aldehydes/B have (in addition to London forces) dipole-dipole forces which are stronger than London forces, but weaker than hydrogen bonds. ✓
Therefore aldehydes/B have lower boiling points/require less energy to overcome intermolecular forces than alcohols/A.✓but higher boiling points / require more energy to overcome intermolecular forces than alkanes/C. ✓

Aldehiede/B het (in toevoeging tot Londonkragte) dipool-dipoolkragte wat sterker is as Londonkragte, maar swakker is as waterstofbinding.
Dus het aldehiede/B laer kookpunte/benodig minder energie om intermolekulêre kragte te oorkom as alkohole/A, maar hoër kookpunte/benodig meer energie om intermolekulêre kragte te oorkom as alkane/C.

OR/*OF*
Aldehydes/B have stronger intermolecular forces than alkanes, but weaker intermolecular forces than alcohols/A. ✓
Therefore aldehydes/B have higher boiling points/ more energy required to overcome intermolecular forces than alkanes/C. ✓ but lower boiling points/ less energy to overcome intermolecular forces than alcohols/A. ✓

Aldehiede/B het sterker intermolekulêre kragte as alkane/C, maar swakker intermolekulêre kragte as alkohole/A.
Dus het aldehiede/B laer kookpunte/ benodig minder energie om intermolekulêre kragte te oorkom as alkohole/A, maar hoër kookpunte/ benodig meer energie om intermolekulêre kragte te oorkom as alkane/C. (4)

3.5 Butanal ✓✓
Butanaal

Marking criteria/*Nasienriglyne*
• Correct stem, i.e. but/*Korrekte stam d.i. but* ✓
• Whole name correct/*Hele naam korrek* ✓

(2)

3.6 Pentan-1-ol ✓✓
OR/*OF*
1-pentanol ✓✓

IF/*INDIEN*: pentanol / pentan-2-ol: $\frac{1}{2}$

(2)
[15]

QUESTION 4/*VRAAG 4*

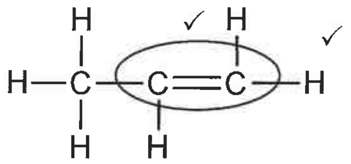
4.1

Marking criteria/*Nasienriglyne*
• Addition reaction / reaction of alkene / reaction of C – C double bond /reaction of unsaturated hydrocarbon✓ *Addisie reaksie / reaksie van 'n alkeen /reaksie van C – C dubbelbinding/reaksie van 'n onversadigde koolwaterstof.*
• (Addition of) hydrogen halide/HX/ hydrogen and halide. ✓ *(Addisie van) waterstofhalied/HX/waterstof en halied.*

The addition ✓of a hydrogen halide/HX ✓to an alkene.
Die addisie van 'n waterstofhalied/HX aan 'n alkeen.

ACCEPT/*AANVAAR*
The addition ✓ of hydrogen/H and a halogen/X ✓ to an alkene.
Die addisie van waterstof/H en 'n halogeen/ X aan 'n alkeen. (2)

4.2



Marking criteria/*Nasienriglyne*
- Whole structure correct: *Hele struktuur korrek:* $\frac{2}{2}$
- Only functional group correct/*Slegs funksionele groep korrek:* Max/Maks: $\frac{1}{2}$

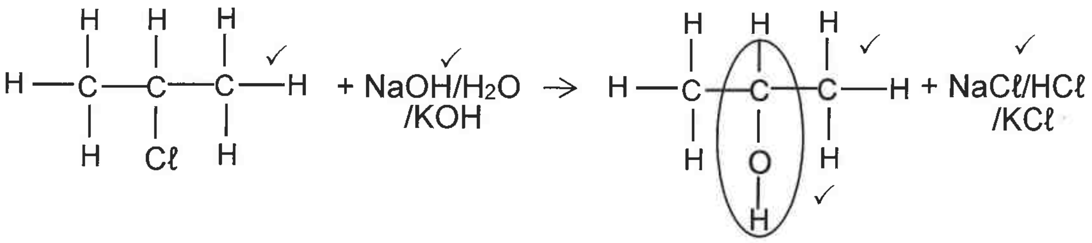
(2)

4.3.1 Cracking/*Kraking* ✓ (1)

4.3.2 C_8H_{18} ✓ (1)

4.4 1,2–dibromo ✓ propane ✓
1,2-dibromopropaan/1,2-dibroompropaan (2)

4.5.1



Marking criteria for the alcohol/*Nasienriglyne vir die alkohol*
- Whole structure of alcohol correct/*Hele struktuur van alkohol korrek:* $\frac{2}{2}$
- Only functional group correct/*Slegs funksionele groep korrek:* $\frac{1}{2}$
- **Accept** – OH
  Aanvaar *- OH*

Notes/*Aantekeninge:*
- If 1-chloropropane used as reactant, 2 marks for the primary alcohol.
  Indien 1-chloropropaan as reaktanse gebruik is, 2 punte vir die primêre alkohol.
- Condensed or semi-structural formula: Max. $\frac{4}{5}$
  Gekondenseerde of semistruktuurformule: Maks. $\frac{4}{5}$
- Molecular formula/*Molekulêre formule:* $\frac{2}{5}$
- Any additional reactants or products: Max. $\frac{4}{5}$
  Enige addisionele reaktanse of produkte: Maks. $\frac{4}{5}$
- If arrow in completely correct equation omitted: Max. $\frac{4}{5}$
  Indien pyltjie in volledige korrekte vergelyking uitgelaat is: Maks. $\frac{4}{5}$
- The product NaCℓ/KCℓ/HCℓ must be marked in conjunction with reactant NaOH/KOH/H_2O.
  Die produk NaCℓ/KCℓ/HCℓ moet in samehang met die reaktans NaOH/KOH / H_2O nagesien word.

(5)

4.5.2
- (Mild) heat/*(Matige) hitte* ✓
- Dilute strong base/NaOH/LiOH/KOH **OR** water/H_2O ✓
  Verdunde sterk basis/NaOH/LiOH/KOH ***OF*** *water/H_2O*

(2)
[15]

QUESTION 5/*VRAAG 5*

5.1.1 (Reaction) rate/*Reaksietempo* ✓ (1)

5.1.2 Surface area/state of division /particle size ✓
Reaksie-oppervlak/*toestand van verdeeldheid/deeltjie grootte* (1)

5.2.1 (Decreasing gradient indicates) rate of reaction is decreasing. ✓
(*Afnemende gradiënt dui aan dat) reaksietempo afneem.* (1)

5.2.2 (Gradient is zero, indicates) reaction rate is zero ✓
(*Gradiënt is nul, wat aandui dat) reaksietempo nul is.*

OR/*OF*
Reaction stopped/is completed.
Reactants/$CaCO_3$ are used up.
Reaksie hou op/is voltooi.
Reaktanse /$CaCO_3$ is opgebruik. (1)

5.3 ave rate/*gem tempo* = $\frac{\Delta V}{\Delta t}$

$$= \frac{500\checkmark(-0)}{60\checkmark(-0)} = 8{,}33\ (cm^3\cdot s^{-1})\ \checkmark$$ (3)

5.4 Equal to/*Gelyk aan* ✓ (1)

5.5 Greater than/*Groter as* ✓

Experiment C/*Eksperiment C*:
- Surface area of $CaCO_3$ powder is greater than that of $CaCO_3$ granules./ More particles are exposed /More particles with correct orientation ✓
- More effective collisions per unit time/Higher frequency of effective collisions. ✓
- Increase in reaction rate.✓

- *Reaksieoppervlak van $CaCO_3$-poeier is groter (as die van $CaCO_3$-korrels /Meer deeltjies met korrekte oriëntasie.*
- *Meer effektiewe botsings per eenheid tyd./Hoër frekwensie van effektiewe botsings*
- *Toename in reaksie tempo*

OR/*OF*
Experiment A/*Eksperiment A*:
- Surface area of $CaCO_3$ granules is smaller/Fewer particles are exposed (than that of powdered $CaCO_3$). Less particles with correct orientation ✓
- Less effective collisions per unit time./Lower frequency of effective collisions. ✓
- Decrease in reaction rate.✓.

- *Reaksieoppervlak van $CaCO_3$ is kleiner/Minder deeltjies is blootgestel (as die van die verpoeierde* $CaCO_3$)./ *Minder deeltjies met korrekte oriëntasie*
- *Minder effektiewe botsings per eenheidtyd./Laer frekwensie van effektiewe botsings.*
- *Afname in reaksie tempo* (4)

5.6

Marking criteria/*Nasienriglyne:*

- Divide volume by 25,7 in / *Deel volume deur 25,7 in* $n = \frac{V}{V_M}$. ✓

  If no substitution step shown, award mark for answer: 0,0195 mol
  Indien geen vervanging stap getoon is nie, ken punt toe vit antwoord: 0,0195 mol
- Ratio/*Verhouding*: $n(CO_2) = n(CaCO_3)$. ✓
- Substitute/*Vervang* 100 in $n = \frac{m}{M}$ or in ratio / *of in verhouding.* ✓
- Final answer/*Finale antwoord:* 1,95 g to/*tot* 2 g. ✓

OPTION 1/*OPSIE 1*

$n(CO_2) = \frac{V}{V_m} = \frac{0,5}{25,7}$ ✓

$= 0,0195$ mol

$n(CaCO_3) = n(CO_2) = 0,0195$ mol ✓

$m(CaCO_3) = nM$

$= 0,0195(100)$

$= 1,95$ g ✓

OPTION 2/*OPSIE 2*

25,7 dm^3 ....1 mol
0,5 dm^3 ....0,0195 mol ✓

100 g ✓...........1 mol
x ....0,0195 mol ✓

x = $m(CaCO_3)$ = 1,95 g ✓

OPTION 3/*OPSIE 3*

$n(CO_2) = \frac{V}{V_m} = \frac{0,5}{25,7}$ ✓

$= 0,0195$ mol

0,0195 mol CO_2 ≡ 0,856 g CO_2 ✓

$m(CO_2)$ produced : $m(CaCO_3)$
44 g : 100 g ✓
0,856 : x
x = 1,95 g ✓$CaCO_3$

(4)
[16]

QUESTION 6/*VRAAG 6*

6.1 Products can be converted back to reactants. ✓
Produkte kan omgeskakel word na reaktanse.

OR/*OF*
Both forward and reverse reactions can take place.
Beide voor-en terugwaartse reaksies kan plaasvind.

OR/*OF*
A reaction which can take place in both directions.
'n Reaksie wat in beide rigtings kan plaasvind. (1)

6.2.1 Remains the same/*Bly dieselfde* ✓ (1)

6.2.2 Increases/*Toeneem* ✓ (1)

6.3

- (When pressure is increased) the reaction that leads to the smaller amount of gas / side with less molecules/number of moles is favoured. ✓
  (Wanneer die druk verhoog word,) word die reaksie wat tot die kleiner hoeveelheid gas /minder gas molekule/aantal mol lei, bevoordeel.
- The reverse reaction is favoured. ✓
  Die terugwaartse reaksie word bevoordeel. (2)

6.4 Endothermic/*Endotermies* ✓

- K_c decreases with decrease in temperature. ✓
- Reverse reaction is favoured. / Concentration of reactants increases. / Concentration of products decreases./Yield decreases ✓
- Decrease in temperature favours an exothermic reaction. ✓

- *K_c neem af met afname in temperatuur.*
- *Terugwaartse reaksie word bevoordeel./Konsentrasie van reaktanse neem toe./Konsentrasie van produkte neem af./Opbrengs neem af*
- *Afname in temperatuur bevoordeel 'n eksotermiese reaksie.*

OR/*OF*

- K_c increases with increase in temperature. ✓
- Forward reaction is favoured. / Concentration of reactants decreases. / Concentration of products increases./Yield increases ✓
- Increase in temperature favours an endothermic reaction. ✓

- *K_c neem toename met toename in temperatuur.*
- *Voorwaartse reaksie word bevoordeel./Konsentrasie van produkte neem toe./Konsentrasie van reaktanse neem af./Opbrengs neem toe*
- *Toename in temperatuur bevoordeel 'n endotermiese reaksie* (4)

6.5

CALCULATIONS USING NUMBER OF MOLES

Mark allocation

- Correct K_c expression (formulae in square brackets). ✓
- Substitution of equilibrium concentrations into K_c expression. ✓
- Substitution of K_c value/*Vervanging van K_c-waarde.* ✓
- Multiply equilibrium concentrations of I_2 and I by 12,3 dm^3. ✓ (**OPTION 1**)
- Multiply equilibrium concentrations of I by 12,3 dm^3 and divide equilibrium mol of I_2 by 12,3 dm^3. ✓(**OPTION 2**)
- Change in $n(I)$ = $n(I$ at equilibrium). ✓
- **USING** ratio/***GEBRUIK*** *verhouding:* $I_2 : I = 1 : 2$ ✓
- Initial $n(I_2)$ = equilibrium $n(I_2)$ + change in $n(I_2)$. ✓
  Substitute 254 $g \cdot mol^{-1}$ as molar mass for I_2. ✓
- Final answer: (26 g - 27,94 g). ✓

BEREKENINGE WAT AANTAL MOL GEBRUIK

Puntetoekenning:

- *Korrekte K_c-uitdrukking (formules in vierkanthakies).*
- *Vervanging van ewewigskonsentrasies in K_c-uitdrukking.*
- *Vermenigvuldig ewewigskonsentrasies van I_2 en I met 12,3 dm^3.(**OPSIE 1**)*
  *Vermenigvuldig ewewigskonsentrasies van I met 12,3 dm^3 en deel ewewigsmol I_2 met 12,3 dm^3(**OPSIE 2**)*
- *Verandering in $n(I)$ = $n(I$ by ewewig)*
- *Aanvanklike $n(I_2)$ = ewewigs $n(I_2)$ + verandering in $n(I_2)$.*
- *Vervang 254 $g \cdot mol^{-1}$ as molêre massa van I_2.*
- *Finale antwoord: (26 g – 27,94 g)*

OPTION 1/*OPSIE 1*

$K_c = \frac{[I]^2}{[I_2]}$ ✓

$3,76\times10^{-3}$ ✓ $= \frac{(4,79\times10^{-3})^2}{[I_2]}$ ✓

$\therefore [I_2] = 6,102 \times 10^{-3}$ mol·dm^{-3}

No K_c expression, correct substitution/*Geen K_c-uitdrukking, korrekte substitusie*: Max./*Maks.* $\frac{8}{9}$	
Wrong K_c expression/*Verkeerde K_c-uitdrukking*: Max./*Maks.* $\frac{6}{9}$	

	I_2	I	
Initial mass (g) *Aanvangsmassa (g)*	(0,1045)(254) ✓ = 26,543 g ✓		
Initial quantity (mol) *Aanvangshoeveelheid (mol)*	0,1045	0	
Change (mol) *Verandering (mol)*	✓ 0,0295	0,0589 ✓	Using ratio ✓
Quantity at equilibrium (mol)/ *Hoeveelheid by ewewig (mol)*	0,0751	0,0589	
Equilibrium concentration (mol·dm^{-3}) *Ewewigskonsentrasie (mol·dm^{-3})*	$6,102 \times 10^{-3}$	$4,79 \times 10^{-3}$	x12,3 ✓

OPTION 2/*OPSIE 2*

	I_2	I	
Initial amount (moles) *Aanvangshoeveelheid (mol)*	x	0	
Change in amount (moles) *Verandering in hoeveelheid* (mol)	0,0295 ✓	0,0589	ratio ✓ *verhouding*
Equilibrium amount (moles) *hoeveelheid* (mol)	x - 0,0295	0,0589 ✓	
Equilibrium concentration (mol·dm^{-3}) *Ewewigskonsentrasie (mol·dm^{-3})*	$\frac{x-0,0295}{12,3}$	$4,79 \times 10^{-3}$	x 12,3 and divide by 12,3 ✓

No K_c expression, correct substitution/*Geen K_c-uitdrukking, korrekte substitusie*: Max./*Maks.* $\frac{8}{9}$	
Wrong K_c expression/*Verkeerde K_c-uitdrukking*: Max./*Maks.* $\frac{6}{9}$	

$K_c = \frac{[I]^2}{[I_2]}$ ✓

$3,76\times10^{-3}$ ✓ $= \frac{(4,79\times10^{-3})^2}{\frac{x-0,0295}{12,3}}$ ✓

x = 0,1045 mol

$\therefore$ m = nM ✓
= (0,1045)(254)
= 26,543 g ✓

CALCULATIONS USING CONCENTRATION

Mark allocation

- Correct K_c expression (formulae in square brackets). ✓
- Substitution of equilibrium concentrations into K_c expression. ✓
- Substitution of K_c value ✓
- Change in n(I) = n(I at equilibrium). ✓
- **USING** ratio: I_2 : I = 1 : 2 ✓
- Initial $[I_2]$ = equilibrium $[I_2]$ + change in $[I_2]$. ✓
- Substitute 254 g·mol^{-1} as molar mass for I_2. ✓
- Final answer 26,543 g. ✓

BEREKENINGE WAT KONSENTRASIE GEBRUIK

Puntetoekenning

- *Korrekte K_c-uitdrukking (formules in vierkanthakies).*
- *Vervanging van ewewigskonsentrasies in K_c-uitdrukking.*
- *Vervanging van K_c-waarde.*
- *Verandering in n(I) = n(I by ewewig).*
- ***GEBRUIK** verhouding I_2 : I = 1 : 2*
- *Aanvanklike $[I_2]$ = ewewigs $[I_2]$ + verandering in $[I_2]$.*
- *Vervang 254 g·mol^{-1} as molêre massa van I_2.*
- *Finale antwoord: 26,543 g*

OPTION 3/*OPSIE 3*

$$K_c = \frac{[I]^2}{[I_2]} \checkmark$$

$$3{,}76\times10^{-3} \checkmark = \frac{(4{,}79\times10^{-3})^2}{[I_2]} \checkmark$$

$[I_2] = 6{,}102 \times 10^{-3}$ mol·dm^{-3}

No K_c expression, correct substitution/*Geen K_c-uitdrukking, korrekte substitusie*: Max./*Maks.* $\frac{8}{9}$

Wrong K_c expression/*Verkeerde K_c-uitdrukking*: Max./*Maks.* $\frac{6}{9}$

	I_2	I	
Initial concentration (mol·dm^{-3}) *Aanvangskonsentrasie (mol·dm^{-3})*	$8{,}497\times10^{-3}$	0	
Change (mol·dm^{-3}) *Verandering* (mol·dm^{-3})	✓ $2{,}395\times10^{-3}$	$4{,}79\times10^{-3}$ ✓	Using ratio ✓
Equilibrium concentration (mol·dm^{-3}) *Ewewigskonsentrasie (mol·dm^{-3})*	$6{,}102 \times 10^{-3}$	$4{,}79 \times 10^{-3}$	

$$c = \frac{m}{MV}$$

$$8{,}497\times10^{-3} = \frac{m}{(254)\checkmark(12{,}3)\checkmark}$$

$\therefore m = 26{,}546$ g ✓

(9)

[18]

QUESTION 7/*VRAAG 7*

7.1.1 Weak/*Swak* ✓

Ionises/Dissociates incompletely/partially (in water) ✓
Ioniseer/Dissosieer/onvolledig/gedeeltelik (in water) (2)

7.1.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$pH = -\log[H_3O^+]$ ✓ 3,85 ✓ $= -\log[H_3O^+]$ $[H_3O^+] = 1,41 \times 10^{-4}\ mol\cdot dm^{-3}$ ✓	$[H_3O^+] = 10^{-pH}$ ✓ $= 10^{-3,85}$ ✓ $= 1,41 \times 10^{-4}\ mol\cdot dm^{-3}$ ✓

(3)

7.1.3 Greater than/*Groter as* ✓ (1)

7.1.4 $CH_3COO^-(aq) + H_2O(\ell)$ ✓ $\rightleftharpoons CH_3COOH(aq) + OH^-(aq)$ ✓

OR/*OF*
$CH_3COONa(aq) + H_2O(\ell)$ ✓ $\rightleftharpoons CH_3COOH(aq) + NaOH(aq)$ ✓

Due to formation of hydroxide/OH^- / the solution is basic/alkaline /pH > 7. ✓
As gevolg van die vorming van hidroksied/OH^- is die oplossing basies/ alkalies /pH > 7

Notes/*Aantekeninge*		
• Reactants ✓ *Reaktanse*	Products ✓ *Produkte*	Ignore balancing *Ignoreer balansering*
• Ignore/*Ignoreer* → and phases/*en fases.*		
• Marking rule 6.3.10/*Nasienreël 6.3.10*		

(3)

7.2.1

Marking criteria/*Nasienriglyne*

- Substitute/*vervang*: 1 x 0,0145 **OR/*OF*** 1 x 14,5 in $c = \frac{n}{V} / \frac{c_a \times V_a}{c_b \times V_b} = \frac{n_a}{n_b}$. ✓
- Use/*Gebruik*: $n(CH_3COOH) : n(NaOH) = 1:1$ ✓
- Final answer/*Finale antwoord*: 0,0145 mol ✓

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$n(NaOH)_{reacted} = cV$ $= 1(0,0145)$ ✓ $= 0,0145$ mol $n(CH_3COOH)_{diluted} = n(NaOH)$ ✓ $= 0,0145$mol ✓	$\frac{c_a \times V_a}{c_b \times V_b} = \frac{n_a}{n_b}$ $\frac{25 \times c_a}{1 \times 14,5}$ ✓ $= \frac{1}{1}$ ✓ $c_a(unreacted) = 0,58\ mol\cdot dm^{-3}$ $n_a(unreacted) = cV$ $= (0,58)(0,025)$ $= 0,0145$ mol ✓

(3)

7.2.2 **POSITIVE MARKING FROM 7.2.1./*POSITEWE NASIEN VANAF VRAAG 7.2.1.***

Marking criteria/*Nasienriglyne*

- Calculate mass/*Bereken massa* CH_3COOH in 25 cm^3 (1,13 g). ✓
- Formula/*Formule*: $n = \frac{m}{M}$. ✓
- Substitute/*Vervang*: $M = 60\ g{\cdot}mol^{-1}$. ✓
- $n(CH_3COOH)_{reacted/reageer} = n_{initial/begin} - n_{unreacted/nie\ reageer}$ ✓
- USE mol ratio/*GEBRUIK molverhouding*: $n(CaCO_3) : n(CH_3COOH) = 1 : 2$.✓
- Substitution of/*Vervanging van* $100\ g{\cdot}mol^{-1}$ in $m = nM$. ✓
- Calculate percentage/*Bereken persentasie*: $\frac{0,217}{1,2} \times 100$ ✓
- Final answer/*Finale antwoord*: 18,08% ✓ (17,92 – 22,92)

$m(CH_3COOH) = \frac{4,52}{100} \times 25$ ✓ $= 1,13\ g$

$n(CH_3COOH)_{ini/aanv.} = \frac{m}{M}$ ✓

$= \frac{1,13}{60}$ ✓ $= 0,01883\ mol$

$n(CH_3COOH)_{rea} = 0,01883 - 0,0145$ ✓ $= 0,0043\ mol$

$n(CaCO_3) = \frac{1}{2} n(CH_3COOH)$

$= 0,5(0,0043)$ ✓

$= 0,00217\ mol$

$m(CaCO_3) = nM$

$= 0,00217(100)$ ✓ $= 0,217\ g$

$\% \ CaCO_3 = \frac{0,217}{1,2} \times 100$ ✓

$= 18,08\ \%$ ✓

(8)

[20]

QUESTION 8/*VRAAG 8*

8.1 Provides path for movement of ions./Ensures(electrical)neutrality in the cell. ✓
Verskaf pad vir beweging van ione./Verseker (elektriese) neutraliteit in die sel. (1)

8.2 (The electrode) where oxidation takes place/electrons are lost. ✓✓
(Die elektrode) waar oksidasie plaasvind/elektrone verloor word.

IF/INDIEN
The electrode that undergoes oxidation /where electrons are lost: $\frac{1}{2}$
Die elektrode wat oksidasie ondergaan/ wat elektrone verloor: $\frac{1}{2}$

(2)

8.3 Mg/Magnesium ✓ (1)

8.4.1 $2H^+ + 2e^- \rightarrow H_2$ ✓✓

Marking criteria/*Nasienriglyne*			
$H_2 \leftarrow 2H^+ + 2e^-$	$(\frac{2}{2})$	$2H^+ + 2e^- \rightleftharpoons H_2$	$(\frac{1}{2})$
$H_2 \rightleftharpoons 2H^+ + 2e^-$	$(\frac{0}{2})$	$2H^+ + 2e \leftarrow H_2$	$(\frac{0}{2})$

- Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.*
- If charge (+) omitted on H^+/*Indien lading (+) weggelaat op* H^+:
  Example/*Voorbeeld:* $2H + 2e^- \rightarrow H_2$ ✓ Max./*Maks:* $\frac{1}{2}$

(2)

8.4.2 Magnesium/Mg ✓ (1)

8.5

OPTION 1/*OPSIE 1*	**Notes/*Aantekeninge***
$E^\theta_{cell} = E^\theta_{reduction} - E^\theta_{oxidation}$ ✓ $= 0$ ✓ $- (-2,36)$ ✓ $E^\theta_{cell} = 2,36$ V ✓	• 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:* $\frac{3}{4}$

OPTION 2/*OPSIE 2*

✓ $2H^+ + 2e^- \rightarrow H_2$	$E^\theta = 0$ V ✓
$Mg(s) \rightarrow Mg^{2+}(aq) + 2e^-$	$E^\theta = +2,36$ V ✓
$Mg(s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$	$E^\theta = +2,36$ V ✓

(4)

8.6 H₂ is a stronger reducing agent ✓ than Cu ✓ and therefore Cu^{2+}/Cu ions are reduced/H_2 is oxidised ✓ Electrons flow from H_2 to Cu.

H_2 is 'n sterker reduseermiddel as Cu en dus word Cu^{2+}/Cu-ione gereduseer/H_2 is geoksideer. Elektrone vloei vanaf H_2 na Cu. (3)
[14]

QUESTION 9/*VRAAG 9*

9.1 **ANY ONE/*ENIGE EEN:***

- 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. **(2 or 0)**
- Decomposition of an ionic compound by means of electrical energy. **(2 or 0)**
- The process during which and electric current passes through a solution/ionic liquid/molten ionic compound. **(2 or 0)**

- *Die chemiese proses waarin elektriese energie omgeskakel word na chemiese energie.* ***(2 of 0)***
- *Die gebruik van elektriese energie om 'n chemiese verandering te weeg te bring.* ***(2 of 0)***
- *Ontbinding van 'n ioniese verbinding met behulp van elektriese energie.* ***(2 of 0)***
- *Die proses waardeur 'n elektriese stroom deur 'n oplossing/ioniese vloeistof/gesmelte ioniese verbinding beweeg.* ***(2 of 0)*** (2)

9.2 Battery/cell/ power source ✓
Battery/sel/kragbron (1)

9.3 Silver nitrate/$AgNO_3$/ Silver ethanoate/CH_3COOAg / Silver fluoride /AgF/ Silver perchlorate $AgC\ell O_4$. ✓
Silwernitraat/$AgNO_3$/ Silweretanoaat/CH_3COOAg / Silwerfloried / AgF / Silwerperchloraat / $AgC\ell O_4$

ACCEPT/*AANVAAR*
$Ag^+(aq)$ (1)

9.4 Remains the same/*Bly dieselfde* ✓

Rate of oxidation is equal to the rate of reduction. ✓
Tempo van oksidasie is gelyk aan die tempo van reduksie. (2)

9.5 $Ag \rightarrow Ag^+ + e^-$ ✓✓

Notes/*Aantekeninge*

$Ag^+ + e^- \leftarrow Ag$ $(\frac{2}{2})$	$Ag \rightleftharpoons Ag^+ + e^-$ $(\frac{1}{2})$
$Ag \leftarrow Ag^+ + e^-$ $(\frac{0}{2})$	$Ag^+ + e^- \rightleftharpoons Ag$ $(\frac{0}{2})$

- Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.*
- If charge (+) omitted on Ag^+/*Indien lading (+) weggelaat op Ag^+:*
  Example/*Voorbeeld:* $Ag \rightarrow Ag + e^-$ ✓

(2)
[8]

QUESTION 10/*VRAAG 10*

10.1.1 (Liquid) Air/*(Vloeibare)Lug* ✓

ACCEPT/*AANVAAR*
Atmosphere/*Atmosfeer* (1)

10.1.2 Natural gas/methane/oil/coal /coke✓
Aardgas/metaan/olie/steenkool/kooks (1)

10.1.3 Iron/iron oxide/Fe/FeO ✓
Yster/ysteroksied/Fe/FeO (1)

10.1.4 NH_3/Ammonia/*Ammoniak* ✓ (1)

10.1.5 Ostwald (process)/*Ostwald(proses)* ✓ (1)

10.1.6 $NH_3 + HNO_3$ ✓ → NH_4NO_3 ✓ Bal ✓

Marking criteria/*Nasienriglyne*
- Reactants ✓ *Reaktanse* Products ✓ *Produkte* Balancing ✓ *Balansering*
- Ignore double arrows./*Ignoreer dubbelpyle.*
- Marking rule 6.3.10./*Nasienreël 6.3.10.*

(3)

10.2.1 NPK ratio/Ratio of primary nutrients ✓
NPK-verhouding/Verhouding van primêre voedingstowwe (1)

10.2.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$\frac{4}{9}$ ✓ x $\frac{X}{100}$ x 20 ✓ = 2,315 kg X = 26 ✓ (26,04)	m(P) = 2,315 kg Mass of 1 part P = $\frac{2,315}{4}$ = 0,57575 Mass of N = (0,57575)(2) = 1,1575 kg Mass of K = (0,57575)(3) = 1,73625 kg Total mass of fertiliser: 1,1575 + 2,315 + 1,73625 = 5,20875 kg ✓ X = $\frac{5,20875}{20}$ x 100 ✓= 26,04 ✓

(3)
[12]

TOTAL/*TOTAAL*: 150

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