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education
DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

NATIONAL SENIOR CERTIFICATE EXAMINATION

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P2)

SEPTEMBER 2019

MARKING GUIDELINE

MARKS/PUNTE: 150

This memorandum consists of 13 pages

Hierdie memorandum bestaan uit 13 bladsye

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QUESTION 1 / VRAAG 1

1.1 A✓✓

1.2 B✓✓

1.3 D✓✓

1.4 B✓✓

1.5 A✓✓

1.6 D✓✓

1.7 C✓✓

1.8 C✓✓

1.9 B✓✓

1.10 C✓✓

[20]

QUESTION/VRAAG 2:

2.1.1 Compounds with (one or more) multiple bonds between the carbon atoms in their hydrocarbon chains.✓✓ (2 or 0)
Verbindings waarin (een of meer) meervoudige bindings tussen koolstof atome van hul koolwaterstofkettings is. (2 of 0) (2)

2.1.2 4-methylpent-2-ene / 4-methyl-2-pentene ✓ ✓
4-metielpent-2-een / 4-metiel-2-penteen (2)

2.1.3 2-methylpent-2-ene **OR** 2-methyl-2-pentene **OR** 2-methylpent-1-ene **OR** 2-methyl-1-pentene **OR** 3-methylpent-2-ene **OR** 3-methyl-2-pentene
3-methylpent-1-ene **OR** 3-methyl-1-pentene ✓ ✓
*2-metielpent-2-een **OF** 2-metielpent-1-een **OF** 3-metielpent-2-een **OF** 3-metielpent-1-een* (2)

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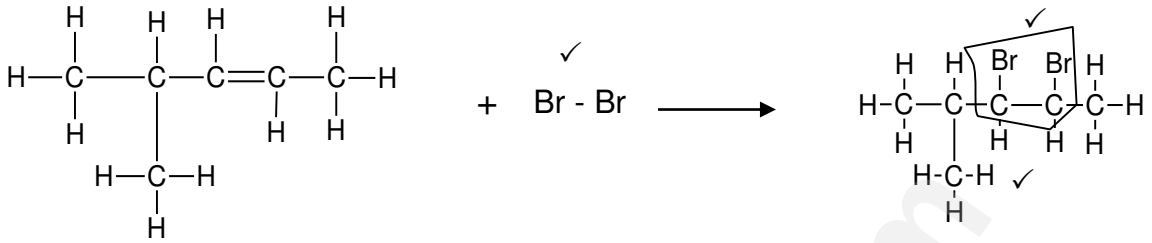


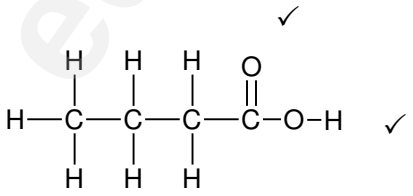
Marking criteria/*Nasienriglyne*
- + Br – Br (accept/*aanvaar* Br_2)
- Functional group / *Funksionele groep* ✓
- Whole structure correct / *Hele struktuur korrek* ✓

Marking criteria/*Nasienriglyne*
- Ignore/*Ignoreer* ⇌
- Accept Br_2 as condensed./*Aanvaar Br_2 as gekondenseerd.*
- Any additional reactants and/or products
  Enige addisionele reaktanse en/of produkte: Max./*Maks.* $\frac{2}{3}$
- Accept coefficients that are multiples.
  Aanvaar koëffisiënte wat veelvoude is.
- Incorrect balancing/*Verkeerde balansering*: Max./*Maks.* $\frac{2}{3}$
- Molecular/condensed formulae/ *Molekulêre-/gekondenseerde formule*: Max./*Maks.* $\frac{1}{3}$
- If only product is given/ *As slegs produk gegee word* Max./*Maks.* $\frac{2}{3}$
- If alken is omitted from equation/*As alkeen uitgelaat is uit vergelyking* Max./*Maks.* $\frac{2}{3}$ (3)

2.1.5 Addition / Halogenation / Bromination ✓
Addisie / Halogenering / Brominasie / Brominering (1)

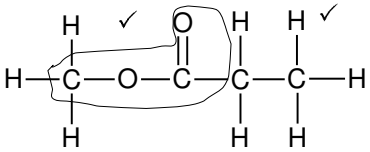
2.1.6 The orange-brown colour of the solution immediately becomes colourless.✓
Die oranje-bruin kleur van die oplossing sal dadelik kleurloos word. (1)

2.2.1 Same molecular formula, but different functional groups.✓✓
Dieselfde molekulêre formules maar verskillende funksionele groepe (2)

2.2.2 

Marking criteria/*Nasienriglyne*
- Functional group / *Funksionele groep*✓
- Whole structure correct / *Hele struktuur korrek* ✓

(2)

2.2.3 

Marking criteria/*Nasienriglyne*
- Functional group / *Funksionele groep*✓
- Whole structure correct / *Hele struktuur korrek* ✓

(2)

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2.2.4 Methanol / *Metanol*✓ (1)

2.2.5 Heat /mild heat✓and concentrated H_2SO_4✓
Hitte en gekonsentreerde swawelsuur (2)

2.2.6 Butanoic acid / *Butanoësuur*✓ (1)

2.2.7
- Butanoic acid has hydrogen bonds (together with dipole-dipole and London forces) ✓/ *Butanoësuur het waterstofbindings (asook dipool-dipoolkragte en Londonkragte)*
- Methyl propanoate has dipole-dipole forces (together with London forces)✓/ *Metielpropanoaat het dipool-dipoolkragte (asook Londonkragte)*
- Hydrogen bonds are stronger than dipole dipole forces✓/ *Waterstof bindings is sterker as dipool-dipoolkragte*
- More energy is needed to overcome the hydrogen bonds✓ */Meer energie is nodig om die waterstofbindings te oorkom.*

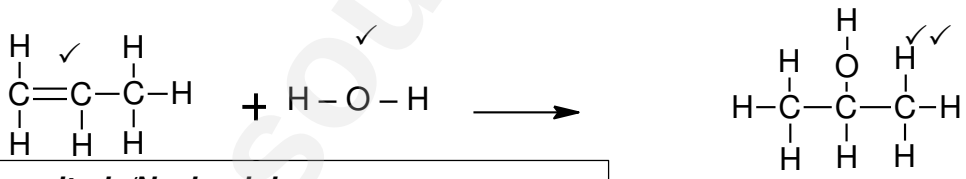
(4)
[25]

QUESTION / VRAAG 3:

3.1.1 (Addition) polymerisation / *(addisie)polimerisasie*✓ (1)

3.1.2 Substitution / hydrolysis / *substitusie / hidrolise*✓ (1)

3.2



Marking criteria/Nasienriglyne
- Correct structural formula of alkene/*Korrekte struktuurformule van alkeen*✓
- + H – O – H / H_2O✓
- OH – on the C2 / *OH op C2*✓
- Whole structure correct / *Hele struktuur korrek* ✓
- Marking rule 6.3.10
- Incorrect alkene used, max 2/4

(4)

3.3 2-bromopropane/*2-bromopropaan* (2)

3.4 (Concentrated) sulphuric acid / H_2SO_4/ *(Gekonsentreerde) swawelsuur* ✓ (1)

3.4 Hydrogenation/ *Hidrogenering / Hidrogenasie* ✓ (1)

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3.5 $C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$ Bal ✓ (✓ ✓ ✓)

Notes/*Aantekeninge*

- Correct alkane / *Korrekte alkaan* (C_3H_8) ✓
- Reactants ✓ Products ✓ Balancing ✓
  Reaktante *Produkte* *Balansering*
- Marking rule /*Nasienreël 3.9*

(4)
[14]

QUESTION / VRAAG 4:

4.1 Hydroxyl (group) / *Hidroksiel(groep)* ✓ (**Accept** hydroxide (group))/(*Aanvaar hidroksied(groep))* (1)

4.2 Primary/*Primêr*✓ (1)

4.3 Boiling point is the temperature ✓ at which the vapor pressure of the substance is equal to the atmospheric pressure. ✓
Kookpunt is die temperatuur waar die dampdruk van 'n stof gelyk is aan die atmosferiese druk. (2)

4.4
- The length of the carbon chain increases from **A** to **D**✓/*Die lengte van die koolstofketting neem toe van **A** na **D**.*
- The strength of the intermolecular forces/London forces increases from **A** to **D**.✓/ *Die sterkte van die intermolekulêre kragte/Londonkragte neem toe van **A** tot **D** .*
- More energy is needed to overcome the intermolecular forces from **A** to **D** ✓and the boiling point increases.✓ */Meer energie is nodig om die intermolekulêre kragte te oorkom en die kookpunt neem toe van **A** tot **D**.* (4)

4.5 A✓ Lowest boiling point / Vapor pressure is inversely proportional to the boiling point.✓/ *Laagste kookpunt / Dampdruk is omgekeerd eweredig aan kookpunt.* (2)
[9]

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QUESTION 5

5.1.1 Temperature/concentration of HCℓ / *temperatuur/konsentrasie van HCℓ* ✓ (1)

5.1.2 Concentration of the $Na_2S_2O_3$ / *Konsentrasie van die* $Na_2S_2O_3$ ✓ (1)

5.1.3 The higher the concentration of the $Na_2S_2O_3$, the higher the rate of reaction/ ✓✓
Hoe hoër die konsentrasie van die $Na_2S_2O_3$, *hoe hoër is die reaksietempo.* (2)

5.1.4 HCℓ will be the limiting reactant. ✓
The volume and the concentration of the two solutions are equal. ✓
Therefore the number of moles will be equal. ✓
The ratio in which the reactants react, is 1:2. ✓
HCℓ is die beperkte reaktant.
Die volume en die konsentrasie van die oplossings is gelyk.
Dus is die aantal mol gelyk.
Die verhouding waarin reaktante reageer is 1:2. (4)

5.2.1 Experiment 6 / *Eksperiment 6* ✓ (1)

5.2.2 The average kinetic energy of the particles in experiment 6 is the highest✓
More particles with $E_K \geq E_a$✓ OR More particles with enough/sufficient kinetic energy.
More effective collisions per unit time✓
Die gemiddelde kinetiese energie van die deeltjies is die hoogste in eksperiment 6
Meer deeltjies met $E_K \geq E_a$
Meer effektiewe botsings per tydseenheid (3)
[12]

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QUESTION 6

6.1.1 NaOH✓ (1)

6.1.2 $Cr_2O_7^{2-}$ ✓ (1)

6.1.3 Exothermic/*Eksotermies*✓ (1)

6.1.4 The colour changes to yellow which indicates that the reverse reaction is favoured. ✓
According to Le Chatelier, the endothermic reaction will be favoured when the temperature is increased. ✓
Die kleur varander na geel wat beteken dat die terugwaartse reaksie bevoordeel word.
Volgens Le Chatelier sal die endotermiese reaksie bevoordeel word wanneer die temperatuur verhoog word. (2)

6.2.1 **CALCULATIONS USING NUMBER OF MOLES/*BEREKENINGE DEUR GEBRUIK TE MAAK VAN AANTAL MOL***

Marking criteria / Nasienriglyne
- Use ratio: 1:1:2✓
- $n(H_2)_{eq} = n(H_2)_{initial} - \Delta n(H_2)$
- $n(I_2)_{eq} = n(I_2)_{initial} - \Delta n(I_2)$ ✓
- $n(HI)_{eq} = n(HI)_{initial} + \Delta n(HI)$ ✓
- Divide equilibrium moles by 2 dm^3✓
- Correct K_c expression✓
- Substitution of K_c value✓
- Substitution of concentration into correct K_c expression✓
- Final answer: 1,15 $mol{\cdot}dm^{-3}$✓

	H_2	I_2	2HI
Initial number of mole *Aanvanklike aantal mol*	5	5	0
Mole reacted or formed *Mol reageer/vorm*	-x	-x	+2x
Number of mole at equilibrium *Aantal mol by ewewig*	5 - x	✓5 - x	2x ✓
Concentration at equilibrium ($mol{\cdot}dm^{-3}$) *Konsentrasie by ewewig*	$\frac{5-x}{2}$	$\frac{5-x}{2}$	x

Ratio / *verhouding*✓

Divide by 2✓
Deel deur 2

$$K_c = \frac{[HI]^2}{[H_2][I_2]} \checkmark$$

$$0,36\checkmark = \frac{[x]^2}{\left(\frac{5-x}{2}\right)\left(\frac{5-x}{2}\right)} \checkmark$$

$x = 1,15\ mol{\cdot}dm^{-3}$

$[HI] = 1,15\ mol{\cdot}dm^{-3}$ ✓

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6.2.1 **CALCULATIONS USING CONCENTRATIONS/*BEREKENINGE DEUR KONSENTRASIE TE GEBRUIK***

Marking criteria / *Nasienriglyne*
- Divide by 2✓
- Use ratio: 1:1:2✓
- $c(H_2)_{eq} = c(H_2)_{initial} - \Delta c(H_2)$
- $c(I_2)_{eq} = c(I_2)_{initial} - \Delta c(I_2)$ } ✓
- $c(HI)_{eq} = c(HI)_{initial} + \Delta c(HI)$ ✓
- Correct K_c expression✓
- Substitution of K_c value✓
- Substitution of concentration into correct K_c expression✓
- Final answer: 1,15 mol·dm^{-3}✓

	H_2	I_2	2HI
Initial concentration (mol·dm^{-3}) *Aanvanklike konsentrasie*	2,5	2,5	0
Change (mol·dm^{-3}) *Verandering*	-x	-x	+2x
Equilibrium concentration(mol·dm^{-3}) *Ewewigskonsentrasie*	2,5 - x ✓	2,5 - x	2x ✓

Divide by 2 ✓ *Deel deur 2* Ratio / *verhouding*✓

$$K_c = \frac{[HI]^2}{[H_2][I_2]} \checkmark$$

$$0,36\checkmark = \frac{[2x]^2}{(5 - x)(5 - x)} \checkmark$$

$x = 0,58$

$[HI] = 2(0,58) = 1,15$ mol·dm^{-3} ✓ (8)

6.2.2 INCREASED/ *TOENEEM*.✓ T
The volume of the container is decreased. ✓
The concentration of both the reactants and products increase. ✓
Die volume van die houer is dus verlaag. Die konsentrasie van beide reaktante en produkte neem toe.

(3)
[16]

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QUESTION 7 / VRAAG 7

7.1.1 F^- / Fluoride ion / *Fluoriedioon* ✓ (1)

7.1.2 Weak acids ionise incompletely in water ✓ to form a low concentration of H_3O^+ ions.✓
Swak sure ioniseer onvolledig in water om 'n lae konsentrasie H_3O^+-ione te vorm. (2)

7.1.3 HBr✓
It has a higher K_a✓, which indicates that it ionises more than HF does ✓
Dit het 'n hoër K_a waarde✓, wat beteken dat dit meer ioniseer as HF✓ (3)

7.1.4 It is a substance that can act as either acid or base. ✓✓
'n Stof wat as óf 'n suur óf 'n basis kan reageer. (2)

7.2.1

$$c = \frac{n}{V} \checkmark$$

$$0,15 = \frac{n}{0,7} \checkmark$$

$$n = 0,105 mol \checkmark$$

Marking criteria / Nasienriglyne

- Formula ✓
- Substitution ✓
- Answer ✓

(3)

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7.2.2 **POSITIVE MARKING FROM QUESTION 7.2.2**

Marking criteria / Nasienriglyne

- multiply by 80%✓
- Any formula: $n=\frac{m}{M}$, $c=\frac{n}{V}$, $pH=-\log[H_3O^+]$ ✓
- Substitute 40 g·mol^{-1} in $n=\frac{m}{M}$ ✓
- $n(H_2SO_4) = \frac{1}{2}(NaOH)$ ✓
- $n(H_2SO_4)_{excess} = n(H_2SO_4)_{initial} - n(H_2SO_4)_{reacted}$ ✓
- Substitution of 0,086 mol·dm^{-3} in $pH=-\log[H_3O^+]$ ✓
- Final answer: 1,066 ✓

80% of / *van* 7,5g

$\frac{80}{100}$ ✓× 7,5

m = 6 g NaOH

$n = \frac{m}{M}$ ✓

$n = \frac{6}{40}$ ✓

n = 0,15 mol NaOH

$n(H_2SO_4) = \frac{1}{2}(0,15) = 0,075$ mol ✓

$n(H_2SO_4)$ in excess = 0,105 - 0,075 ✓

$n(H_2SO_4)$ in excess = 0,03 mol

$c = \frac{n}{V}$

$c = \frac{0,03}{0,7}$

c = 0,043 mol·dm^{-3} H_2SO_4

$[H_3O^+] = 2(0,043) = 0,086$ mol·dm^{-3}

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

$= -\log(0,086)$ ✓

= 1,066 ✓

(7)
[18]

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QUESTION 8 / VRAAG 8

8.1 Fe is a stronger reducing agent✓ than Cu ✓and reduces Cu^{2+} to Cu✓
Fe is 'n sterker reduseermiddel as Cu ✓en reduseer Cu^{2+} tot Cu. ✓
OR/OF
Cu is a weaker reducing agent ✓ than Fe✓ and $Cu^{2+}$is reduced to Cu✓
Cu is 'n swakker reduseermiddel as Fe en Cu^{2+}word gereduseer na Cu. (3)

8.2.1 Ensures electrical neutrality / Complete the circuit / Separate electrolytes✓
Verseker elektriese neutraliteit / Voltooi die stroombaan / Skei elektroliete (1)

8.2.2 Cu / Copper / *Koper* ✓ (1)

8.2.3 $2Cr + 3Cu^{2+}$ ✓ $\rightarrow 2Cr^{3+} + 3Cu$ ✓ balancing ✓ (3)

8.2.4 $E^{\theta} = E^{\theta}_{cathode/katode} - E^{\theta}_{anode/anode}$ ✓
$E^{\theta} = +0,34$ ✓$- (-0,74)$ ✓
$E^{\theta} = 1,08$ V ✓ (4)

8.2.5 HIGHER THAN/*GROTER AS*✓

+

If Cu^{2+} ion concentration is increased✓, the forward reaction is favoured. ✓ / *As die Cu^{2+} ioon konsentrasie toeneem word die voorwaartse reaksie bevoordeel.*
OR / ***OF***
Rate of forward reaction increases✓ with an increase in the concentration✓ /
Tempo van reaksie neem toe met 'n toename in konsentrasie (3)

8.2.6 Decrease / *Afneem*✓ (1)
[16]

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QUESTION 9 / VRAAG 9

9.1 An electrolyte is a solution/liquid/dissolved substance that conducts electricity through the movement of ions. ✓✓

'n Elektroliet is 'n oplossing/vloeistof/opgeloste stof wat elektrisiteit gelei deur die beweging van ione. (2)

9.2 Sodium chloride✓ (1)

9.3 $2C\ell^-(aq) \rightarrow C\ell_2(g) + 2e^-$ ✓✓

Marking guidelines/*Nasienriglyne*

- $C\ell_2(g) + 2e^- \leftarrow 2C\ell^-(aq)$ $(\frac{2}{2})$ $2C\ell^-(aq) \rightleftharpoons C\ell_2(g) + 2e^-$ $(\frac{0}{2})$
  $C\ell_2(g) + 2e^- \rightleftharpoons 2C\ell^-(aq)$ $(\frac{1}{2})$ $2C\ell^-(aq) \rightarrow C\ell_2(g) + 2e^-$ $(\frac{0}{2})$
- Ignore if charge on electron is omitted./*Ignoreer indien lading op elektron uitgelaat is.*
- If a charge of an ion is omitted e.g. $2C\ell(aq) \rightarrow C\ell_2(g) + 2e^-$ /*Indien lading op ioon uitgelaat is bv.* $2C\ell(aq) \rightarrow C\ell_2(g) + 2e^-$ Max./*Maks*: $\frac{1}{2}$

(2)

9.4 A ✓ Oxidation takes place at A/ *Oksidasie vind plaas by A.* ✓ (2)

9.5 $2H_2O(\ell) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$ ✓✓
The OH^- formed is a base/*Die OH^- wat vorm, is 'n basis.* ✓

Marking guidelines/*Nasienriglyne*

- $H_2(g) + 2OH^-(aq) \leftarrow 2H_2O(\ell) + 2e^-$ $(\frac{2}{2})$ $2H_2O(\ell) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$ $(\frac{0}{2})$
  $H_2(g) + 2OH^-(aq) \rightleftharpoons 2H_2O(\ell) + 2e^-$ $(\frac{1}{2})$ $2H_2O(\ell) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$ $(\frac{0}{2})$
- Ignore if charge on electron is omitted./*Ignoreer indien lading op elektron uitgelaat is.*
- If a charge of an ion is omitted. Max./*Maks*: $\frac{1}{2}$

(3)

9.6 Platinum is a conductor/inert✓/*Platinum is 'n geleier/onreaktief* (1)
[11]

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QUESTION 10 / VRAAG 10

10.1.1 Fractional distillation of (liquid) air / *fraksionele distillasie van (vloeibare) lug* ✓ (1)

10.1.2 NH_3 / Ammonia / *Ammoniak* ✓ (1)

10.1.3 $2NH_3 + H_2SO_4$ ✓ $\rightarrow (NH_4)_2SO_4$ ✓ (✓ bal)

Marking criteria / Nasienriglyne

- Reactants ✓
- Products ✓
- Balancing ✓

(3)

10.2. **OPTION 1**

$\frac{7}{11}$ ✓ × 22% = 14 %

$\frac{14}{100}$ × 5kg ✓ = 0,7 kg

$n = \frac{m}{M} = \frac{700}{14}$ ✓ = 50 mol ✓

OPTION 2

$\frac{7}{11}$ ✓ × $\frac{22}{100}$ × 5 ✓ = 0,7

$n = \frac{m}{M} = \frac{700}{14}$ ✓ = 50 mol ✓

Marking criteria / Nasienriglyne

- Ratio
- Multiply by 5 kg
- Divide by 14
- Answer: 50 mol

(4)

[9]

TOTAL/TOTAAL:150

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