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**

## 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✓✓

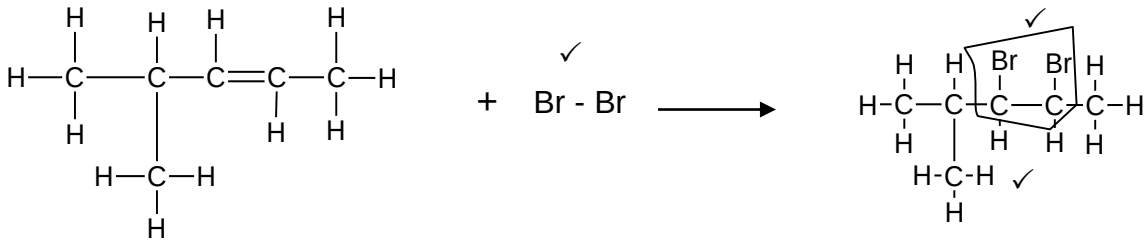
**[20]**

## 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)



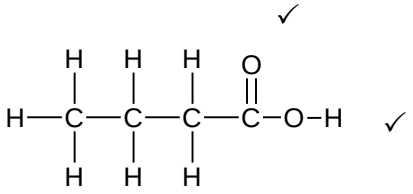

**Marking criteria/*Nasienriglyne***
- + Br – Br (accept/*aanvaar* $Br_2$)
- Functional group / *Funksionele groep* ✓
- Whole structure correct / *Hele struktuur korrek* ✓

**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)

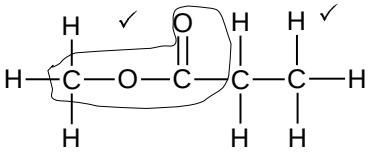
2.1.6 The orange-brown colour of the solution immediately becomes colourless.✓
*Die oranje-bruin kleur van die oplossing sal dadelik kleurloos word.* (1)

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)

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*.

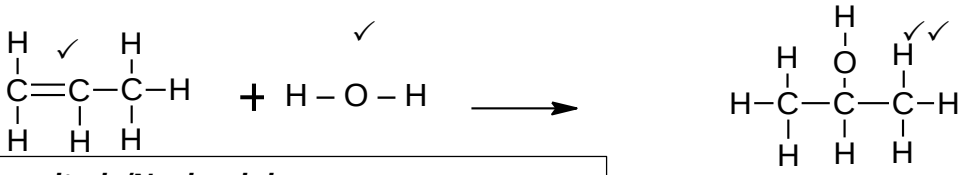
(4)
**[25]**

**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)

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]**

## 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]**

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

Ratio / *verhouding*✓

Divide by 2✓
*Deel deur 2*

$K_c = \frac{[HI]^2}{[H_2][I_2]}$ ✓

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

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

$[HI] = 1,15\ mol \cdot dm^{-3}$ ✓ (8)

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*✓

$K_c = \frac{[HI]^2}{[H_2][I_2]}$ ✓

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

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]**

## 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)

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]**

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

8.2.6 Decrease / *Afneem*✓ (1)
**[16]**

## 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]**

## 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 %

$\frac{14}{100} \times 5kg$ ✓ = 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**