Province of the EASTERN CAPE EDUCATION

NATIONAL SENIOR CERTIFICATE/
NASIONALE SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

JUNE/*JUNIE* 2018

PHYSICAL SCIENCES P2/*FISIESE WETENSKAPPE V2*
MARKING GUIDELINE/*NASIENRIGLYN*

MARKS/*PUNTE*: 150

This marking guideline consists of 10 pages./ *Hierdie nasienriglyn bestaan uit 10 bladsye.*

QUESTION/*VRAAG 1*

1.1 D ✓✓ (2)

1.2 C ✓✓ (2)

1.3 B ✓✓ (2)

1.4 D ✓✓ (2)

1.5 B ✓✓ (2)

1.6 D ✓✓ (2)

1.7 A ✓✓ (2)

1.8 A ✓✓ (2)

1.9 B ✓✓ (2)

1.10 D ✓✓ (2)

[20]

QUESTION/*VRAAG 2*

2.1.1 Organic compound that consist of carbon and hydrogen atoms only. ✓✓
Organiese verbindings wat slegs uit koolstof- en waterstofatome bestaan.
(2 or/of 0) (2)

2.1.2 Alkanes ✓/*Alkane* (1)

2.1.3 C_2H_5 ✓ (1)

2.1.4 $2C_4H_{10} + 13O_2$ ✓ $\rightarrow$ $8CO_2 + 10H_2O$ ✓ Bal ✓

Notes/Aantekeninge:

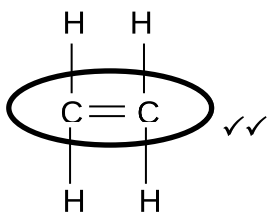
- Reactants✓ Products✓ Balancing✓
  Reaktanse *Produkte* *Balansering*
- Ignore double arrows and phases./ *Ignoreer dubbelpyle en fases.*
- Marking rule 6.3.10/*Nasienreël 6.3.10.*
- If condensed structural formulae used:/*Indien gekondenseerde struktuurformules gebruik:* Max./*Maks. 2/3*

(3)

2.1.5 EXOTHERMIC ✓/*EKSOTERMIES* (1)

2.1.6 The chemical process in which longer chain hydrocarbon molecules are broken✓ into shorter more useful molecules. ✓
Die chemiese proses waarin langer ketting koolwaterstofmolekules afgebreek word in korter meer bruikbare molekules. (2)

2.1.7



Marking criteria/Nasienriglyne:

- Whole structure correct/ *Hele struktuur korrek:* 2/2
- Only functional group correct.
  Slegs funksionele groep korrek. Max./*Maks..* 1/2

(2)

2.1.8 CATALYTIC✓/*KATALITIES* (1)

2.1.9 UNSATURATED✓/*ONVERSADIG*

Contains double bonds OR multiple bonds between C atoms.✓
Bevat dubbelbindings OF meervoudige bindings tussen C-atome. (2)

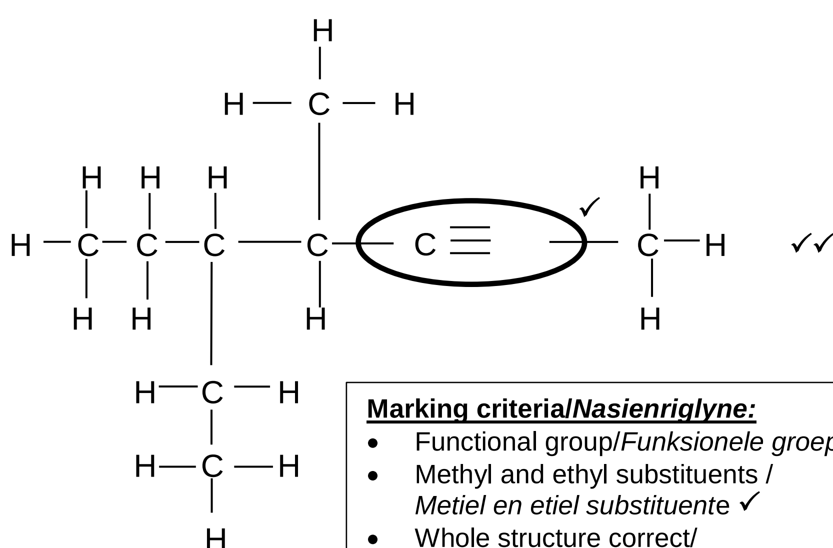
2.1.10 2,3-dimethylbut-2-ene/2,3-dimethyl-2-b*uteen*
2,3-dimetielbut-2-een/2,3-dimetiel-2-buteen

Marking Criteria/*Nasienriglyne:*

- Correct stem i.e but-2-ene/2-butene.
  Korrekte stam bv.but-2-een/2-buteen. ✓
- Substituent dimethyl correctly identified. ✓
  Substituent dimetiel korrek geïdentifiseer.
- Substituents correctly numbered, hyphens and commas correctly used. ✓
  Substituente korrek genommer, koppeltekens en kommas korrek gebruik.

(3)

2.2.1



Marking criteria/*Nasienriglyne:*

- Functional group/*Funksionele groep.* ✓
- Methyl and ethyl substituents /
  Metiel en etiel substituente ✓
- Whole structure correct/
  Hele struktuur korrek ✓ 3/3

(3)

2.2.2 Pentan-2-one✓✓/2-pentanone
Pentan-2-oon/2-pentanoon (2)

[23]

QUESTION/*VRAAG 3*

3.1 A bond or an atom or a group of atoms that determine(s) the physical and chemical properties of a group of organic compounds. ✓✓
ʼn Binding of ʼn atoom of ʼn groep atome wat die fisiese en chemiese eienskappe van ʼn groep organiese verbindings bepaal. **(2 or/*of 0)*** (2)

3.2.1 Aldehyde ✓/*Aldehied* (1)

3.2.2 Carboxile group ✓/*Karboksiel-groep* (1)

3.3.1 185,4(˚C) ✓ (1)

3.3.2
- Compound **B**/carboxylic acid has <u>hydrogen bonding</u> ✓(in addition to London forces/Dispersion forces/Induced dipole forces/dipole-dipole forces.).
  *Verbinding **B**/karboksielsuur het <u>waterstofbindings</u> behalwe Londonkragte/Dispersiekragte/Geïnduseerde dipoolkragte en dipool-dipoolkragte)*
- *H*ydrogen bonds are <u>stronger</u> ✓ than London forces/Dispersion forces/Induced dipole forces and dipole-dipole forces.
  Waterstofbindings is <u>sterker</u> as Londonkragte/Dispersiekragte/ Geïnduseerde dipoolkragte en dipool-dipoolkragte.
- <u>More energy will be needed to overcome/break(intermolecular) forces</u>. ✓
  <u>Meer energie word benodig om (intermolekulêre) kragte te oorkom/ te breek</u>. (3)

3.4.1 Organic molecules with the same molecular formula ✓ but different structural formulae. ✓
Organiese verbindings met dieselfde molekulêre formule maar verskillende struktuurformules. (2)

3.4.2 CHAIN ✓/*KETTING* (1)

3.4.3 SMALLER THAN ✓/*KLEINER AS*

STRUCTURE/*STRUKTUUR:*
Compound **D** <u>are branched</u>/more compact/more spherical/smaller contact area/smaller surface(over which intermolecular forces act.) ✓
*<u>Verbinding **D** is meer vertak</u>/meer kompak/meer series/kleiner kontak area/kleiner oppervlak(waaroor intermolekulêre kragte werk.)*
INTERMOLECULAR FORCES/*INTERMOLEKULÊRE KRAGTE*
<u>Weaker/Less strength/Decrease in strength of Van der Waals forces</u>/ London forces/Dispersion forces. ✓
<u>Swakker/Afname in sterkte van Van der Waalskragte</u>/Londonkragte/ Dispersiekragte.

ENERGY/*ENERGIE:*
Less energy needed to overcome/break (intermolecular) forces. ✓
Minder energie benodig om (intermolekulêre) kragte te oorkom/breek.

OR/*OF*

STRUCTURE/*STRUKTUUR:*
Compound **C** is a straight chain/less compact/less spherical/larger contact area/larger surface(over which intermolecular forces act.) ✓
*Verbinding **C** is 'n reguitketting/minder kompak/minder sferies/groter kontakarea/groter oppervlak(waaroor intermolekulêre kragte werk.)*
INTERMOLECULAR FORCES/*INTERMOLEKULÊRE KRAGTE*
Stronger/More strength/Increase in strength of Van der Waals forces/ London forces/Dispersion forces. ✓
Sterker/Toename in sterkte van Van der Waalskragte/Londonkragte/ Dispersiekragte.
ENERGY/*ENERGIE*
More energy needed to overcome/break (intermolecular) forces. ✓
Meer energie word benodig om (intermolekulêre) kragte te oorkom/breek. (4)
[15]

QUESTION/*VRAAG 4*

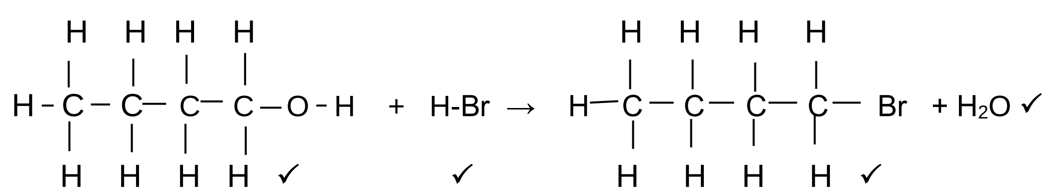
4.1.1 Substitution ✓/*Substitusie* (1)

4.1.2 Eliminasie ✓/Dehydration
Eliminasie/Dehidrasie/Dehidratering (1)

4.2.1 Hydrogenation ✓
Hidrogenasie/Hidrogenering (1)

4.2.2 Pt ✓/Ni/Pd/Platinum/Nickel/*Nikkel*/Palladium (1)

4.3



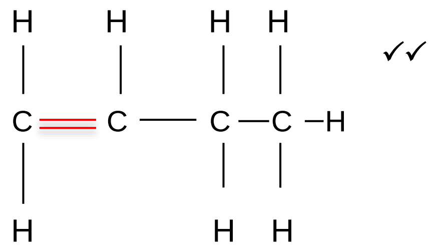
Notes/*Aantekeninge*:

- Ignore double arrows/*Ignoreer dubbelpyle.*
- Accept/*Aanvaar* H_2O
- Any additional reactants and/ or products
  Enige addisionele reaktanse en/of produkte: Max./*Maks.* 3/4
- Accept any coefficients that are multiples:
  Aanvaar koëffisiente wat veelvoude is:
- Incorrect balancing/*Verkeerde balansering:* Max./*Maks. 3/4*
- *Molecular/Condensed formulae*
  Molekulêre/gekondenseerde formule: Max./*Maks. 2/4*
  Accept/*Aanvaar:* -OH as condensed/*-OH as gekondenseerd*

(4)

4.4.1 (Concentrated) sulphuric acid ✓/hydrogen sulphate/H_2SO_4
Gekonsentreerde swaelsuur/waterstofsulfaat/ H_2SO_4 (1)

4.4.2



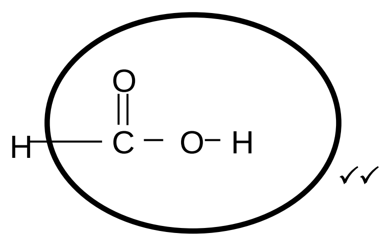
Marking criteria/*Nasienriglyne*:

- Whole structure correct/*Hele struktuur korrek: 2/2*
- Only functional group correct
  Slegs funksionele groep korrek Max./*Maks. 1/2*

(2)

4.5.1
- Heat ✓/mild temperature over waterbath.
  Verhit/matige temperatuur oor 'n waterbad.
- Add concentrated sulphuric acid/H_2SO_4 ✓
  Voeg gekonsentreerde swawelsuur/waterstofsulfaat)/H_2SO_4 by. (2)

4.5.2



Marking criteria/*Nasienriglyne:*
Only functional group ✓
Slegs funksionele groep
Whole structure correct ✓
Hele struktuur korrek 2/2

(2)

4.5.3 Butyl ✓ methanoate ✓/ *butielmetanoaat* (2)
[17]

QUESTION/*VRAAG* 5

5.1.1 Use magnesium powder. ✓
Gebruik magnesiumpoeier. (1)

5.1.2 Increase concentration (H_2SO_4) ✓/*Toename in konsentrasie (H_2SO_4)* (1)

5.1.3 DECREASES ✓/*VERLAAG* (1)

5.1.4 NO EFFECT ✓/*GEEN EFFEK* (1)

5.2.1 Surface area ✓ (of Zn)/State of division(of Zn)
Oppervlaksarea(van Zn) /Toestand van verdeeldheid(van Zn) (1)

5.2.2 Reaction stops ✓/come to completion/no more hydrogen gas is produced since <u>zinc is used up</u>. ✓
Reaksie stop/kom tot stilstand/geen waterstofgas word geproduseer want <u>sink is opgebruik.</u> (2)

5.2.3 EQUAL TO ✓/*GELYK AAN*

The same Volume of $H_2(g)$ was produced. ✓
Dieselfde volume $H_2(g)$ *is geproduseer.* (2)

5.2.4 (a) Average rate/*Gemiddelde tempo* = $\Delta V/\Delta t$
= (0,06 - 0) ✓/(30 - 0) ✓
= 2×10^{-3}✓($mol.dm^{-3}.s^{-1}$) or/*of 0,002* (3)

(b) n = cV ✓= 0,4 x 100/1000 ✓ = 0,04 mol ✓ (3)

(c)

<u>Marking criteria/*Nasienriglyne:*</u>
• Use 24,3 $dm^3.mol^{-1}$ substituted in the correct formula.✓ *Gebruik 24,3* $dm^3.mol^{-1}$ *vervang in die korrekte formule.* • Calculate n(HCl) reacted using the mol ratio 1 : 2. ✓ *Bereken* $n(HCl)_{gereageer}$ *deur molverhouding 1 : 2 te gebruik*. • Calculate n(HCl) reacted ✓ *Bereken* $n(HCl)_{gereageer}$ • Use 36,5 $g.mol^{-1}$ substitute in correct formule. ✓ *Gebruik 36,5* $g.mol^{-1}$ *vervang in die korrekte formule.* • Finale antwoord/*Final answer.* (1,28–1,31 g)✓

<u>POSITIVE MARKING from QUESTION 5.2.4 b</u>
<u>POSITIEWE NASIEN vanaf VRAAG 5.2.4 b</u>

$n(H_2)_{produced/berei}$ = V/V_m= 0,06/<u>24,3</u>✓ = $2,47 \times 10^{-3}$mol (0,002)

$n(HC\ell)_{reacted/gereageer}$ = $2 \times 2,47 \times 10^{-3}$✓ Ratio/*Verhouding*
= $4,94 \times 10^{-3}$ mol (0,004)

$n(HC\ell)_{remaining/oorgebly}$ = $n_{initial/begin}$ - $n_{produced/berei}$
= 0,04 – $4,94 \times 10^{-3}$✓
= 0,03506 mol (0,036)

m = nM = 0,03506 x <u>36,5</u>✓= 1,28 g✓ **Range/*Gebied*** (1,28–1,314 g) (5)

5.2.5 The minimum energy required to start a chemical reaction. ✓✓
Die minimum energie benodig om 'n reaksie te begin. **(2 or/*of* 0)** (2)

5.2.6 Experiment/*Eksperiment* **III** ✓ (1)

5.2.7
- A catalyst ✓ provides an alternative pathway of lower activation energy(E_A). ✓
  'n Katalisator verskaf 'n alternatiewe pad van laer aktiveringsenergie.
- More particles will have sufficient/enough kinetic energy(E_k) to react. ✓ /More particles with $E_k \geq E_A$.
  Meer deeltjies het voldoende(genoegsame) kinetiese energie(E_k) om te reageer./Meer deeltjies het $E_k \geq E_A$.
- More effective collisions per unit time/second. ✓
  Meer effektiewe botsings per eenheidstyd/sekonde.

  OR/*OF*

  Rate/frequency of effective collisions increases.
  Tempo/frekwensie van effektiewe botsings neem toe. (4)

[27]

QUESTION/*VRAAG 6*

6.1 Stage at which the rate of forward reaction equals the rate of reverse. ✓✓
Die toestand/stadium in 'n chemiese reaksie wanneer die tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie.

OR/*OF*

The stage where the concentrations/quantities of reactants and products remain constant.
Die toestand wanneer die konsentrasies/hoeveelhede van reaktanse en produkte konstant bly. **(2 or/*of* 0)** (2)

6.2 Closed system ✓/*Geslote sisteem*
Reversible reaction ✓/*Omkeerbare reaksie.* (2)

6.3.1 NO EFFECT ✓/*GEEN EFFEK* (1)

6.3.2 INCREASES ✓/*TOENEEM* (1)

6.4.1 REVERSE ✓/TERUGWAARTSE (1)

6.4.2 Increase in pressure ✓ /Decrease volume; Addition of a catalyst. ✓
Verhoog druk/Afname in volume; Byvoeging van 'n katalisator. (2)

6.5.1 LOW (yield) ✓/*LAE (opbrengs)*
K_c is low. ✓/K_c *is laag.* (2)

6.5.2

Marking Criteria/Nasienriglyne:

- Divide by 34 to calculate $n(H_2S)_{equilibrium.}$ ✓
  Verdeel deur 34 om $n(H_2S)_{ewewig}$ te bereken.
- Use mole ratio H_2:H_2S/*Gebruik mol verhouding H_2:H_2S* ✓ *(1 : 1)*
- Divide $n(H_2S)_{equilibrium}$ by V./*Verdeel $n(H_2S)_{ewewig}$ deur V.* ✓
- Correct K_c expression/*Korrekte K_c uitdrukking.* ✓
- Substitution of K_c -value./*Vervanging van K_c waarde.* ✓
- Substitution into Kc expression/*Substitueer in K_c uitdrukking.* ✓
- Calculate /*Bereken* $n(H_2)_{equilibrium/ewewig}$ ✓
- Final answer/*Finale antwoord* $n(H_2)_{initial/begin}$ = 2,45 mol ✓

OPTION/*OPSIE* 1

$n(H_2S)_{equilibrium/ewewig}$ = m/M = 17/34 ✓= 0,5 mol

	H_2	S	H_2S	
$n_{initial/begin}$ (mol)			0	ratio/ *verhouding* ✓
Δn (mol)	0,5	0,5	0,5	
$n_{equilibrium/ewewig}$(mol)			0,5	
$c_{equilibrium/ewewig}$ ($mol.dm^{-3}$)	$n_{equilibrium/ewewig}$/**V**		0,5/**V**	÷**V** ✓

K_c = $[H_2S]/[H_2]$ ✓

$2,56 \times 10^{-1}$ ✓ = (0,5/**V**)/($n(H_2)_{equilibrium/ewewig}$/**V**) ✓

$n(H_2)_{equilibrium/ewewig}$ = 1,95 mol ✓

$n(H_2)_{initial/begin}$ = 0,5 + 1,95 = 2.45 mol ✓ (8)

6.5.3 **POSITIVE MARKING from QUESTION 6.5.2**
POSITIEWE NASIEN vanaf VRAAG 6.5.2

90/100 n_i(S) ✓ = n_i(S) – 0,5 ✓

n_i(S) = 5 mol ✓ (3)

6.5.4 Graph/*Grafiek* **Q**✓

- As temperature increases, K_c decreases. ✓
  Indien die temperatuur toeneem, neem K_c af.
- $[H_2S]$ decreases✓/$[H_2]$ increases.
  *$[H_2S]$ neem af**/** $[H_2]$ verhoog.*
- Reverse reaction is favoured by an increase in temperature. ✓
  Terugwaartse reaksie word bevoordeel deur 'n verhoging in temperatuur. (4)

[26]

QUESTION/*VRAAG* 7

7.1.1 Hydrolysis ✓/*Hidrolise* (1)

7.1.2 Transfer of proton✓(H^{+}) occurs./ CO_3^{2-} gains a proton / H_2O loses a proton.
Oordrag van proton(H^{+}) vind plaas/CO_3^{2-} ontvang 'n proton/H_2O verloor 'n proton(H^{+}). (1)

7.1.3 OH^-✓ (1)

7.1.4 $K_b < 1 \times 10^{-14}$✓ (1)

7.1.5 Substance that can act either as an acid or base./ ✓✓
'n Stof wat as beide suur of basis kan optree. (2)

7.1.6 H_2CO_3 ✓ (1)

7.1.7 CO_3^{-2} ✓ (1)

7.2.1 An acid that donates TWO protons/H^+/H_3O^+-ions. ✓✓
'n Suur wat TWEE protone/H^+/H_3O^+-ione vrystel. (2)

7.2.2 $pH = - \log [H_3O^+]$✓
$1,3$✓$= - \log [H_3O^+]$
$[H_3O^+]= 10^{-1,3}$

$[OH^-][H_3O^+] = 1 \times 10^{-14}$
$[OH^-] \times 10^{-1,3} = 1 \times 10^{-14}$✓
$[OH^-] = 10^{-12,7}$ mol.dm^{-3}✓ $= 1,995 \times 10^{-13}$ mol.dm^{-3} (4)

7.3.1 **POSITIVE MARKING FROM Q 7.2.2/*POSITIEWE NASIEN VANAF V7.2.2***
OPTION /OPSIE 1
$[H_3O^+] = 10^{-1,3}$ mol.dm^{-3}
$[Acid] = ½ \times 10^{-1,3}$ ✓ $= 0,0251$ mol.dm^{-3}

Dilution $c_1V_1= c_2V_2$
$0,0251(8) = c_2 \times 100$✓
$c_2(dilute) = 2,008 \times 10^{-3}$ mol.dm^{-3}

n(acid reacting) = cV = $2,008 \times 10^{-3} \times 25/1000$✓ $= 5,02 \times 10^{-5}$ mol

n(base reacting) = $2 \times 5,02 \times 10^{-5}$ ✓$= 1,004 \times 10^{-4}$ mol

c(base) = n/V = $1,004 \times 10^{-4}/14,2 \times 10^{-3}$ ✓ $= 7,07 \times 10^{-3}$ mol.dm^{-3}✓ (6)

OPTION/OPSIE 2

$[H_3O^+] = 10^{-1,3}$ mol.dm^{-3}
[Acid] = ½ x$10^{-1,3}$ ✓ = 0,0251 mol.dm^{-3}

$c_1V_1 = c_2V_2$
$(0,0251)(8) = c_2 \times 100$✓
$c_2 = 2,008 \times 10^{-3}$ mol.dm^{-3}

$\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$

$\frac{2,008 \times 10^{-3}(25)}{c_b \times 14,2}$ ✓ ✓ $= \frac{1}{2}$ ✓

$c_b = 7,07 \times 10^{-3}$ mol.dm^{-3} ✓

Range/*Gebied* ($7,04 \times 10^{-3}$ to/*tot* $7,07 \times 10^{-3}$ mol.dm^{-3})

7.3.2 **B**✓
Titration of a strong base and a strong acid ✓ (solution at end point neutral.)
Titrasie van 'n sterk basis en 'n sterk suur (oplossing is neutraal by eindpunt.)
(2)
[22]

TOTAL/*TOTAAL*: 150