QUESTION 6/*VRAAG 6*

6.1.1 One mole is the amount of a substance having the same number of particles as there are atoms in 12 g carbon-12. ✓✓
Een mol is die stofhoeveelheid wat dieselfde getal deeltjies het as wat daar atome in 12 g koolstof-12 is.
[2 or 0] (2)

6.1.2 $Na_2CO_3 + 2HC\ell$ ✓ $\rightarrow$ $2NaC\ell + H_2O + CO_2$ ✓ (2)

6.1.3 **Mark allocation/Nasienriglyne:**

- Formula for/ *Formule vir* volume ✓
- Substitution of 0,306 and 24,45 ✓/*Vervanging van 0,306 en 24,45*
- Using ratio/*Gebruik verhouding* ✓
- Formula for/*Formule vir* mass ✓
- Substitutions of moles ✓and 106 ✓ /*Vervanging van mole en 106*
- Answer with units/*Antwoord met eenheid* ✓

$n = \frac{V}{V_m}$ ✓

$n = \frac{0,306}{24,45}$ ✓

$n = 0,0125$ mol of CO_2

$Na_2CO_3 : CO_2$
1 : 1 ✓ (use of the ratio/*gebruik die verhouding*)
$n = 0,0125$ mol of Na_2CO_3

$n = \frac{m}{M}$ ✓

✓ $0,0125 = \frac{m}{106}$ ✓

$m = 1,33$ g ✓ (1,325 – 1,33 g) (7)

6.1.4 **POSITIVE MARKING FROM QUESTION 6.3**
POSITIEWE NASIEN VANAF VRAAG 6.3
OPTION 1/*OPSIE 1*

$$\% \ CaCO_3 \text{ unreacted} = \frac{1,5 - 1,33}{1,5} \times 100 \quad \checkmark$$

$$= 11,33\% \ \checkmark \ (11,33\% - 11,67\%)$$

OPTION 2/*OPSIE 2*

$$\% \ CaCO_3 \text{ reacted} = \frac{1,33}{1,5} \checkmark \times 100 = 88,67\%$$

$$\% \text{ unreacted} = 100 - 88,67 = 11,33\% \ \checkmark$$

OPTION 3/*OPSIE 3*

$$n = \frac{m}{M}$$

$$n = \frac{1,5}{106}$$

$$n = 0,0142 \text{ mol}$$

initial mol – reacted mol = 0,0142 – 0,0125 = 0,0017 mol unreacted

$$\% \ CaCO_3 \text{ unreacted} = \frac{0,0017}{0,0142} \checkmark \times 100 = 11,97\% \ \checkmark$$

(2)

6.2.1 Sulphuric acid ✓ (1)
Swawelsuur

6.2.2

Mark allocation/Punte toekenning:

- Any one of the formulae/Enige een van formules ✓
- Substitution of/*Vervanging van* 3 g (5 g – 2 g) ✓
- Ratio/*Verhouding 1:1* ✓
- Substitution of moles and volume in dm^3 /*Vervanging van mol en volume in* dm^3 ✓
- Answer with units/*Antwoord met eenheid* ✓

OPTION 1/*OPSIE 1*

$n = \frac{m}{M}$

$= \frac{3}{65}$ ✓ ← (5 – 2)

= 0,0462 mol of Zn

✓ any one of the two formula/Enige een van formules

Ratio Zn : H_2SO_4

1 : 1 ✓

$n(H_2SO_4)$ = 0,0462 mol

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

$= \frac{0,0462}{0,05}$ ✓

= 0,92 $mol \cdot dm^{-3}$ ✓

OPTION 2/*OPSIE 2*

$n = \frac{m}{M}$

$= \frac{3}{65}$ ✓

= 0,0462 mol of Zn

✓ any one of the two formula/Enige een van formules

Ratio Zn : H_2SO_4

1 : 1 ✓

$n(H_2SO_4)$ = 0,0462 mol

m = nM

= (0,0462)(98)

= 4,5276 g of H_2SO_4

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

$= \frac{4,5276}{(98)(0,05)}$ ✓

= 0,92 $mol \cdot dm^{-3}$ ✓

OPTION 3/*OPSIE 3*

$n = \frac{m}{M}$

$= \frac{5}{65}$

= 0,0769 mol of Zn initial

✓ any one of the two formula/Enige een van formules

$n = \frac{m}{M}$

$= \frac{2}{65}$

= 0,0308 mol of Zn final

n_{used} = 0,0769 ✓ – 0,0308 = 0,0461 mol

Ratio Zn : H_2SO_4

1 : 1 ✓

$n(H_2SO_4)$ = 0,0461 mol

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

$= \frac{0,0461}{0,05}$ ✓

= 0,92 $mol \cdot dm^{-3}$ ✓

(5)

[19]

1.8 D ✓✓ (2)

QUESTION/*VRAAG 6*

6.1.1 $2H_2O_2$ (aq) ✓ → $2H_2O$ (ℓ) + O_2 (g) ✓ (2)

6.1.2 The catalyst lowers the activation energy of the reaction ✓✓
Accept: catalyst speeds up the reaction
'n Katalisator verlaag die aktiveringsenergie van die reaksie ✓✓
Aanvaar: katalisator laat die reaksie vinniger plaasvind (2)

6.1.3

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$n = \frac{V}{V_m}$ ✓ $n = \frac{0,6}{24,45}$ ✓ n = 0,0245 mole/*mol* O_2 produced/*gevorm* H_2O_2 : O_2 2 : 1 ✓ n = 0,049 mole/*mol* H_2O_2 reacted/*reageer* $n = \frac{m}{M}$ ✓ $0,049 = \frac{m}{34}$ ✓ m = 1,67 g ✓ (Accept range 1,36 – 1,67 g) *(Aanvaar 1,36 – 1,67 g)*	From the balanced equation: *Vanaf gebalanseerde vergelyking*: 68g H_2O_2 → 24,45 dm^3 O_2 ✓✓ X g H_2O_2 → 600 x 10^{-3} dm^3 ✓ $X = \frac{68 \times 0,6}{24,45}$ ✓ ✓ X = 1,67 g ✓

(6)

6.2.1 Magnesium ✓,
the mass of magnesium after 3 minutes/at the end of the reaction was zero ✓
OR the magnesium is used up

Magnesium ✓,
die massa magnesium na 3 minute/aan die einde van die reaksie was nul ✓
OF die magnesium is opgebruik (2)

Kwantitatiewe Aspekte
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6.2.2

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

$$0,36 = \frac{n}{0,5} \checkmark$$

n = 0,18 mole/*mol*HCℓ used/*gebruik*

$$n = \frac{m}{M}$$

$$n = \frac{1,2}{24} \checkmark$$

n = 0,05 mole/*mol* Mg reacted/*reageer*

Mg : HCℓ
1 : 2 ✓
0,1 mole/*mol* ✓ HCℓ reacted/*reageer*

Moles of HCℓ left in the test tube = 0,18 $\overset{\checkmark}{-}$ 0,1 = 0,08 mole ✓/*Mol HCℓ ongereageer in die proefbuis = 0,18 – 0,1 = 0,08 mol* (7)

[19]

Kwantitatiewe Aspekte
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1.7 A ✓✓

1.8 B ✓✓

QUESTION/*VRAAG* 5

5.1.1 Smallest whole number ratio of elements that make up the substance. ✓✓
Kleinste heelgetalverhouding van die elemente waaruit die stof bestaan. (2)

5.1.2

OPTION/*OPSIE* 1

$n(H_2O) = m/M$
$= 19,35/18$✓
$= 1,075$ mol

$n(H) = 2n(H_2O)$✓
$= 2 \times 1,075$
$= 2,15$ mol

$n = m/M$
$2,15 = m/1$✓
$m(H) = 2,15$ g✓

$n(CO_2) = m/M$
$= 47,1/44$✓
$= 1,07$ mol

$n(C) = n(CO_2)$✓
$= 1,07$ mol

mol C:mol H
1,07:2,15
1:2✓

Empirical formula: CH_2 ✓
Empiriese formule

OPTION/*OPSIE* 2

%H in $H_2O = 2$✓$/18 \times 100$✓
$= 11,11\%$

M(H) in H_2O
$= 11,11\%$ of 19,35 g✓
$= 2,15$ g ✓

%C in $CO_2 = 12/44 \times 100$
$= 27,27\%$

M(C) in CO_2 $= 27,27\%$ of 47,1 g ✓
$= 12,84$ g (to 12,85 g)

mol C: mol H
12,84/ 12 : 2,15 /1✓
1,07 : 2,15 (÷ 1.07
1:2✓

Empirical formula: CH_2 ✓
Empiriese formule

(8)

POSITIVE MARKING FROM QUESTION 5.1.2
POSITIEWE NASIEN VANAF VRAAG 5.1.2

5.1.3 $M(CH_2) = 1(12) + 2(1) = 14$ g.mol^{-1}
M(true formula)/M(empirical formula)/
M(ware formule)/M(Empiriese formule) = 28/14 = 2 ✓

C_2H_4 **x** = 2 and **y** = 4 ✓(both/*beide*) (2)

5.2.1 $n(CaO) = m/M$✓ $= 11,76/56$✓ $= 0,21$ mol

$n(CaCO_3) = n(CaO)$✓ $= 0,21$ mol

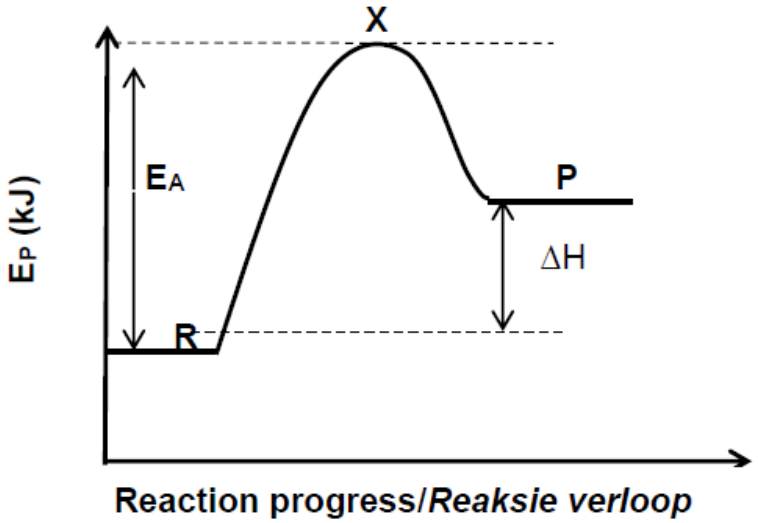
$m(CaCO_3) = n/M = (0,21)(100)$ ✓ $= 21$ g

% purity = m(pure compound/m(impure sample) x 100

% suiwerheid = m(suiwer verbinding)/m(onsuiwer monster) x 100

Impure mass/*Onsuiwer massa* = 2100/80 ✓= 26,25 g ✓ (6)

5.2.2



Marking criteria ***Nasienriglyne***	Marks ***Punte***
Correct shape as shown. *Korrekte vorm soos getoon.*	✓
Reactants(R) and Products (P) correctly labelled. *Reagense (R) en Produkte (P) korrek benoem.*	✓
Activation energy (E_A) correctly indicated. *Aktiveringsenergie (E_A) korrek aangedui.*	✓
Activated complex (**X**) correctly indicated. *Geaktiveerde kompleks (**X**) korrek aangedui.*	✓
ΔH correctly indicated. *ΔH korrek aangedui.*	✓

Notes/Aantekeninge:
If graph drawn for exothermic reaction: Max. 2/5
Indien grafiek geteken is vir eksotermiese reaksie. Maks. 2/5

(5)
[23]

QUESTION 6 / *VRAAG 6*

6.1 $M(Na_2SO_4) = 142\ g{\cdot}mol^{-1}$ √

$15 - 7{,}05 = 7{,}95g$ √ Na_2SO_4

$n = \frac{m}{M} = \frac{7.95}{142} = 0{,}0559$ mol √ Na_2SO_4

$n = \frac{m}{M} = \frac{7{,}05}{18} = 0{,}392$ mol √ H_2O

Ratio 1 : 7 $\therefore x = 7$ √ (5)

6.2 6.2.1 in 100 g:

$\frac{39.9}{12} = 3{,}325$ mol C √

$\frac{6.7}{1} = 6{,}7$ mol H√

$\frac{53.4}{16} = 3{,}3375$ mol O √ Ratio: $C_1H_2O_1$ √

$M(C_1H_2O_1) = 12 + 2(1) + 16 = 30\ g{\cdot}mol^{-1}$ √
and 60/30 = 2
Molecular formula / *molekulêre formule*: $C_2H_4O_2$ √ (6)

6.2.2 acid donates √ 1 H^+ ion √ / *suur doneer (skenk) 1 H^+ ion* (2)

6.3 6.3.1 $2HC\ell + CaCO_3$ √ $CaC\ell_2 + CO_2 + H_2O$ √√ balancing/*balansering* (3)

6.3.2 $M(CaCO_3) = 40 + 12 + 3(16) = 100\ g{\cdot}mol^{-1}$ √

$n = \frac{m}{M} = \frac{0.5}{100}$ √ $= 0{,}005$ mol √ $CaCO_3$

1 mol $CaCO_3$: 2 mol $HC\ell$ therefore/*dus* 0,005 : 0,01 mol $HC\ell$ √

$M(HC\ell) = 1 + 35{,}5 = 36{,}5\ g{\cdot}mol^{-1}$ √

$M = nM = 0{,}01(36{,}5) = 0{,}365\ g = 365\ mg$ √ stomach acid/*maagsuur* (6)

[22]

1.5 C ✓✓ (2)

1.9 C ✓✓ (2)

QUESTION 6/*VRAAG 6*

6.1 The mass of one mol (of the substance). ✓
Die massa van een mol (van die stof). (1)

6.2 $n(H_2O) = \frac{m}{M}$ ✓
$= \frac{100}{18}$ ✓
$= 5,56$ mol ✓ (3)

6.3
6.3.1 Smallest whole number ratio of the elements that make up the substance. ✓✓
Kleinste heelgetalverhouding van die elemente waaruit die stof bestaan. (2)

6.3.2 $\%C = (\frac{3,758}{5,325})(100) = 70,573$
$\%H = (\frac{0,316}{5,325})(100) = 5,934$
$\%O = (\frac{1,251}{5,325})(100) = 23,493$ } ✓

$n = \frac{m}{M}$ ✓

$n(C) = \frac{70,573}{12✓} = 5,881$ mol

$n(H) = \frac{5,934}{1✓} = 5,934$ mol

$n(O) = \frac{23,493}{16✓} = 1,468$ mol

mol C : mol H : mol O = 4 : 4 : 1 ✓
∴ C_4H_4O ✓ (7)

Marking criteria/*Nasienriglyne:*
- Calculate % of three elements. ✓
  Bereken % van drie elemente.
- Formula/*Formule* $n = \frac{m}{M}$ ✓
- Use molar mass C ✓
  Gebruik molêre massa C
- Use molar mass H ✓
  Gebruik molêre massa H
- Use molar mass O ✓
  Gebruik molêre massa O
- Ratio/*Verhouding* ✓
- Empirical formula/*Empiriese formule*: C_4H_4O ✓

6.3.3 $M(C_4H_4O) = 4(12) + 4(1) + 16 = 68$ g·mol^{-1}
$\frac{136}{68} = 2$ } ✓
∴ Molecular formula/*Molekulêre formule*: $C_8H_8O_2$ ✓

Notes/*Aantekeninge*:
- If correct formula without calculation - two marks
  Indien korrekte formule sonder berekening – twee punte.

(2)
[15]

Kwantitatiewe Aspekte
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QUESTION 7/*VRAAG 7*

7.1 A reactant whose amount limits/determines the amount of product obtained in a chemical reaction. ✓✓
Die reaktans waarvan die hoeveelheid die hoeveelheid produk wat in 'n chemiese reaksie verkry word, beperk/bepaal.

OR/*OF*
The reactant that produces the least amount of product. ✓✓
Die reaktans wat die minste hoeveelheid produk sal lewer.

OR/*OF*
The reactant that will be used up first during a chemical reaction. ✓✓
Die reaktans wat eerste opgebruik word tydens 'n chemiese reaksie. (2)

7.2
7.2.1

$$n(Fe) = \frac{m}{M}$$
$$= \frac{20}{56} \checkmark$$
$$= 0{,}357 \text{ mol Fe}$$

✓Any formula
Enige formule

$$n(S) = \frac{m}{M}$$
$$= \frac{10}{32} \checkmark$$
$$= 0{,}313 \text{ mol S}$$

From balanced equation/*Uit gebalanseerde vergelyking*:
1 mol Fe reacts with/*reageer met* 1 mol S ✓
n(S) < n(Fe)
The limiting reactant is S./*Die beperkende reaktans is S.* ✓ (5)

7.2.2 **POSITIVE MARKING FROM QUESTION 7.2.1.**
POSITIEWE NASIEN VAN VRAAG 7.2.1.

$$n(\text{Fe used / gebruik}) = \frac{m}{M}$$
$$0{,}313 = \frac{m}{56} \checkmark$$
$\therefore$ m(Fe used/*gebruik*) = 17,5 g

m(excess/*oormaat*) = 20 – 17,5 ✓ = 2,5 g ✓ (3)

7.3

Marking criteria/*Nasienriglyne:*

- Substitute/use M(MgO) = 40 g·mol^{-1} ✓
  Vervang/gebruik M(MgO) = 40 g·mol^{-1}
- Use ratio of n(Mg) : n(MgO) = 1 : 1 ✓
  Gebruik verhouding n(Mg) : n(MgO) = 1 : 1
- Use M(Mg) = 24 g·mol^{-1} ✓
  Gebruik M(Mg) = 24 g·mol^{-1}
- Calculate m(MgO) = 24 g or n(MgO) = 0,6 mol that will be obtained if 80% yield. ✓
  Bereken m(MgO) = 24 g of n(MgO) = 0,6 mol wat verkry sal word as 80% opbrengs.
- Calculate m(Mg) or n(Mg) needed. ✓
  Bereken m(Mg) of n(Mg) benodig.
- Final answer/*Finale antwoord*: 22,5 g ✓

OPTION 1/*OPSIE 1*

$$n(MgO) = \frac{m}{M}$$
$$= \frac{30}{40}\checkmark$$
$$= 0{,}75 \text{ mol}$$

From balanced equation/*Uit gebalanseerde vergelyking*:
n(Mg) = n(MgO) = 0,75 mol ✓

$$n(Mg) = \frac{m}{M}$$
$$0{,}75 = \frac{m}{24}\checkmark$$
$$m(Mg) = 18 \text{ g}$$

If 18 g Mg gives 80% yield, then mass Mg needed for 100% yield:
As 18 g Mg 80% gee, dan is massa Mg nodig vir 100%
18 g ……24 g MgO ✓
x g ……30 g
✓

$$\therefore m(Mg) = \frac{(18)(30)}{24} = 22{,}5 \text{ g} \checkmark$$

OPTION 2/*OPSIE 2*

$$n(MgO) = \frac{m}{M}$$
$$= \frac{30}{40}\checkmark$$
$$= 0{,}75 \text{ mol}$$

From balanced equation/*Uit gebalanseerde vergelyking*:
n(Mg) = n(MgO) = 0,75 mol ✓

If 0,75 mol Mg gives 80% yield, then mol Mg needed for 100% yield:
As 0,75 mol Mg 80% gee, dan is mol Mg nodig vir 100%:
0,75 mol Mg ……0,6 mol MgO ✓
x mol Mg……0,75 mol Mg

$$n(Mg) = \frac{(0{,}75)(0{,}75)}{0{,}6}\checkmark$$
$$= 0{,}9375 \text{ mol}$$

$$n(Mg) = \frac{m}{M}$$
$$0{,}9375 = \frac{m}{24}\checkmark$$
$$\therefore m(Mg) = 22{,}5 \text{ g} \checkmark$$

OPTION 3/*OPSIE 3*	**OPTION 4/*OPSIE 4***
From balanced equation: *Uit gebalanseerde vergelyking:* 2 mol Mg ……..2 mol MgO 48 g Mg ✓……80 g ✓ MgO ✓ x g Mg ……..30 g MgO x = 18 g Mg If 30 g MgO is 80% yield, then Mg needed: *As 30 g MgO 80% opbrengs is, dan is Mg benodig:* 18 g ……24 g MgO ✓ x g ……..30 g $\therefore m(Mg) = \frac{18 \times 30}{24}$ ✓ = 22,5 g ✓	$n(MgO) = \frac{m}{M} = \frac{30}{40\checkmark} = 0,75$ mol From balanced equation: *Uit gebalanseerde vergelyking:* n(Mg) = n(MgO) = 0,75 mol ✓ If 0,75 mol Mg gives 80% yield, then mol Mg needed for 100% yield: *As 0,75 mol Mg 80% gee, dan is mol Mg nodig vir 100% opbrengs:* $n(Mg) = (\frac{100}{80})(0,75)$ ✓✓= 0,9375 mol $n(Mg) = \frac{m}{M}$ ✓ $0,9375 = \frac{m}{24}$ $\therefore m(Mg) = 22,5$ g ✓

(6)
[16]

2.3 C ✓✓ (2)

VRAAG 5

5.1 $A\ell_2(SO_4)_3$ ✓ (1)

5.2 $M\ [A\ell_2(SO_4)_3]$ = (27 x 2) + (32 x 3) + (16 x 12)
= 54 + 96 + 192
= 342 g·mol^{-1} ✓

$\%A\ell = \frac{54}{342} \times 100 = 15{,}79\%$ ✓
$\%S = \frac{96}{342} \times 100 = 28{,}07\%$ ✓
$\%O = \frac{192}{342} \times 100 = 56{,}14\%$ ✓ (4)

5.3 $n(A\ell) = \frac{15{,}79}{27} = 0{,}585$ ✓ $\therefore \frac{0{,}585}{0{,}585} = 1$
$n(S) = \frac{28{,}07}{32} = 0{,}877$ ✓ $\therefore \frac{0{,}877}{0{,}585} = 1{,}5$
$n(O) = \frac{56{,}14}{16} = 3{,}509$ ✓ $\therefore \frac{3{,}509}{0{,}585} = 6$

molêre verhouding = 1 : 1,5 : 6 (x2)
= 2 : 3 : 12 ✓

∴ Empiriese formule: $A\ell_2S_3O_{12}$ ✓ (5)
[10]

VRAAG 8

8.1 $2H_2 + O_2$ (✓reaktanse) $\longrightarrow 2H_2O$ (✓produkte) (✓bal.) (3)

8.2 Waterstof.✓ Suurstof is in oormaat.✓ (2)

8.3 $n(H_2) = \frac{m}{M}$ ✓ $= \frac{25}{2}$ ✓ = 12,5 mol H_2 ✓

vanaf die gebalanseerde vergelyking: 2 mol H_2 vervaardig 2 mol H_2O
∴ 12,5 mol H_2 sal 12,5 mol H_2O vervaardig ✓

Teoretiese opbrengs: $n = \frac{m}{M} \Longrightarrow 12{,}5 = \frac{m}{18}$ ✓ ∴ m = 225 g ✓

opbrengs = $\frac{\text{werklike opbrengs}}{\text{teoretiese opbrengs}} \times 100\%$
$= \frac{140}{225} \times 100\%$ ✓
= 62,22% ✓ (8)
[13]