1.8 C ✓✓ (2)

1.9 D ✓✓ (2)

QUESTION 7/*VRAAG 7*

7.1 Hydrated: surrounded by water molecules✓/*Gehidrateer: omring deur water molekules* (1)

7.2 $Na_2CO_3(s) \rightarrow 2Na^+(aq) + CO_3^{2-}(aq)$
Products: ✓ Balancing: ✓/*Produkte:/Balansering:* (2)

7.3.1 The amount of a substance having the same number of particles as there are atoms in 12 g carbon-12. ✓✓/*Die hoeveelheid van 'n stof met dieselfde getal partikels as wat daar atome in 12 g koolstof-12 is.* (2)

7.3.2 Acid-base ✓/gas forming (reaction)/*Suur-basis/gasvormend (reaksie)* (1)

7.3.3 $c(HCl) = \frac{n(HCl)}{V(HCl)}$ ✓

$1 = \frac{n(HCl)}{0,005}$ ✓

$n = 0,005$ mol ✓ (3)

7.4 **POSITIVE MARKING FROM 7.3.3/ *POSITIEWE NASIEN VANAF 7.3.3***

$n(NaCl) : n(HCl) = 1 : 1$

$n(NaCl) = \frac{1}{1} \times 0,005$✓

$n(NaCl) = 0,005$ mol

$n(NaCl) = \frac{m}{M}$✓

$0,005$✓ $= \frac{m}{58,5}$✓ ✓

$m = 0,29$ g ✓ (5)

Marking criteria/Nasienriglyne:
- **Using** ratio/***Gebruik*** *verhouding*✓
- Formula/*Formule* $n = \frac{m}{M}$✓
- Substituting of/ *Invervanging van* 0,005 mol✓ & 58,5 $g \cdot mol^{-1}$ ✓in $n = \frac{m}{M}$
- Final answer/*Finale antwoord*: 0,29 g ✓

[14]

QUESTION 8/*VRAAG 8*

8.1 A solution that conducts electricity✓✓ (through the movement of ions). / *'n Oplossing wat elektrisiteit deur die beweging van ione gelei.*
NOTE/*LET WEL*: If learners refer to movement of electrons, a mark is forfeited/*Indien leerder verwys na beweging van elektrone, penaliseer met 1 punt.* (2)

8.2.1 What is the relationship between a type of substance and its (electrical) conductivity? ✓✓/*Wat is die verwantskap tussen 'n tipe stof en sy (elektriese) geleidingsvermoë?*

OR/*OF*

How does a type of substance affect the (electrical) conductivity of a substance? ✓✓/*Hoe beïnvloed 'n tipe stof die (elektriese) geleidingsvermoë van 'n stof?* (2)

Marking Criteria/Nasienriglyne:	
Dependent and independent variable correctly stated. *Afhanklike en onaafhanklike veranderlikes korrek genoem.*	✓
Ask a question about the relationship between the independent and dependent variables. *Vra 'n vraag oor die verwantskap tussen die onafhanklike en afhanklike veranderlikes.*	✓

8.2.2 Conductivity ✓/*Geleidingsvermoë* (1)

8.2.3 Type of a substance ✓/*Tipe stof* (1)

8.2.4 Mass OR Temperature ✓/*Massa OF Temperatuur* (1)

8.3.1 A solution of $CaCl_2$ ✓/*'n Oplossing* $CaCl_2$
It is the strongest electrolyte ✓/*Dit is die sterkste elektroliet.*

OR/*OF*

It has the highest concentration of (chloride) ions ✓/*Dit het die grootste getal (chloried) ione.* (2)

8.3.2 A solution of sugar ✓/*'n Oplossing van suiker*
It contains no free ions. ✓/*Dit bevat geen vrye ione nie.* (2)

8.4 n(C):C(H):n(O)

$$\frac{m(C)}{M[C]} : \frac{m(H)}{M[H]} : \frac{m(O)}{M[O]}$$

Assume mass of 100 g of a sample/*Aanvaar massa van 100 g van 'n monster*

$$\frac{40}{12}\checkmark : \frac{6,67}{1}\checkmark : \frac{53,33}{16}\checkmark$$

3,33 : 6,67 : 3,33

$$\frac{3,33}{3,33} : \frac{6,67}{3,33} : \frac{3,33}{3,33}$$

1 : 2 : 1✓

Empirical formula/*Empiriese formule*: CH_2O

$M(CH_2O) = 12 + 2 + 16 = 30\ g \cdot mol^{-1}$✓

Factor/*Faktor* $= \frac{180}{30} = 6$✓

∴ Molecular formula/*Molekulêre formule* is: $C_6H_{12}O_6$ ✓ (7)

[11]

QUESTION 9/*VRAAG 9*

9.1 Precipitation reaction ✓/*Presipitasiereaksie* (1)

9.2.1 Sulphate ✓/*Sulfaat* (1)

9.2.2 $BaCO_3 + 2HNO_3$ ✓ $\rightarrow Ba(NO_3)_2 + CO_2 + H_2O$✓

Reactants✓; products✓; balancing✓
Reaktanse/produkte/ balansering (3)

9.3.1 $n(Na_2CO_3) = \frac{m}{M}$✓

$= \frac{5}{106}$✓

$= 0,047$ mol

$n(BaCO_3) : n(Na_2CO_3)$

$1 : 1$✓

$m(BaCO_3) = n \times M$

$= 0,047 \times 197$✓

$= 9,26$ g ✓ (Range/*Gebied*: 9,25 – 9,87) (5)

Marking criteria/Nasienriglyne:
- Formula/*Formule* n = $\frac{m}{M}$✓
- Substitution/Inv*ervanging* ✓
- Using ratio/*Gebruik verhouding* ✓
- Multipy by/*Vermenigvulding met* 197 g·mol^{-1} ✓in n = $\frac{m}{M}$
- Final answer/*Finale antwoord*: 9,26 g ✓

9.3.2 **POSITIVE MARKING FROM 9.3.1/ *POSITIEWE NASIEN VANAF 9.3.1***

$$\%\ \text{yield/}opbrengs = \frac{\text{actual yield/}werklike\ opbrengs}{\text{theoretical yield/}teoretiese\ opbrengs} \times 100$$

$= \frac{8,3}{9,26} \times 100$ ✓

$= 89,63\%$✓ (Range/*Gebied*: 84,26 – 89,64) (2)

[12]

1.7 D ✓✓ (2)

QUESTION 6/*VRAAG 6*

6.1.1 Gas forming ✓/*Gasvormende reaksie* ✓ (1)

6.2.1 $M(Na_2CO_3) = 2(23) + 12 + 3(16)$
$= 106$ ✓ $g \cdot mol^{-1}$ ✓ (2)

6.2.2 **POSITIVE MARKING FROM QUESTION 6.2.1**
POSITIEWE NASIEN VANAF VRAAG 6.2.1

$n(Na_2CO_3) = \frac{m}{M}$
$= \frac{10,6}{106}$ ✓
$= 0,1$ mol ✓ (2)

6.2.3 **POSITIVE MARKING FROM QUESTION 6.2.2**
POSITIEWE NASIEN VANAF VRAAG 6.2.2

OPTION 1/*OPSIE 1*:
$n(Na_2CO_3) : n(CO_2)$
1 : 1✓
Thus: $n(CO_2)$=0,1 mol
$n(CO_2) = \frac{m}{M}$ ✓
$0,1 = \frac{m}{44}$ ✓
$m = 4,4$ g ✓

OPTION 2/ OPSIE 2:
106 g of Na_2CO_3 : 44 g of CO_2 ✓✓
10,6 g : 4,4 g CO_2 ✓✓

(4)

6.2.4 $n(CO_2) = \frac{V_{CO_2}}{V_m}$
$= \frac{4,87}{22,4}$ ✓
$= 0,217$ mol

NOTE/ *NOTA*:
One mark for any one formula
Een punt vir enige een formule

$n(CO_2) : n(NaCl)$
1 : 2 ✓
n(NaCl) = 0,434 mol

$n(NaCl) = \frac{m}{M}$ ✓
✓ $0,434 = \frac{m}{58,5}$ ✓
$m = 25,16$ g ✓

NOTE/ *NOTA*:
If ratio 1:2 is not given, allocate two marks for 0,434 in the substitution.
Indien verhouding 1:2 nie gewys word nie, gee twee punte vir 0,434 vir die invervanging.

(6)

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6.3

OPTION1/*OPSIE 1*:

Mass of H_2O = 14.2 – 5,3
= 8,9 g ✓

$$n(Na_2CO_3) = \frac{m}{M} = \frac{5,3}{106} \checkmark = 0,05\,mol$$

$$n(H_2O) = \frac{m}{M} = \frac{8,9}{18} \checkmark = 0,5\,mol$$

$Na_2CO_3 : H_2O$

$\frac{0,05}{0,05} : \frac{0,5}{0,05}$ ✓ Divide by smallest number

1 : 10

Thus x = 10 ✓

OPTION 2/*OPSIE 2*:

Mass of H_2O = 14,2 – 5,3

= 8,9g ✓

$M(Na_2CO_3)$ = 160 g·mol^{-1} $M(H_2O)$ = 18 g·mol^{-1}

$$n(Na_2CO_3) : n(H_2O)$$

$$\frac{m(Na_2CO_3)}{M(Na_2CO_3)} : \frac{m(H_2O)}{M(H_2O)} \checkmark$$

$$\frac{5,3}{160} : \frac{8,9}{18} \checkmark$$

$$0,05 : 0,5$$

$$\frac{0,05}{0,05} : \frac{0,5}{0,05}$$ ✓ Divide by smallest number

1 : 10

Thus x =10 ✓

(5)
[20]

QUESTION 7/*VRAAG 7*

7.1 Distilled water does not contain free ions. ✓
Gedistilleerde water bevat geen vrye ione nie. ✓ (1)

7.2 Electrolyte ✓✓/*Elektroliet* ✓✓ (2)

7.3 $AgNO_3(s) \rightarrow Ag^+(aq)$ ✓ + $NO_3^-(aq)$ ✓
NOTE/*NOTA*: Phases need not be shown/ *Fases kan uitgelaat word.* (2)

7.4.1 The conductivity of $AgNO_3$ solution will increase with an increase in the concentration of the $AgNO_3$ solution at a constant temperature. ✓✓
Die geleidingsvermoë van die $AgNO_3$ oplossing sal toeneem met 'n toename in die konsentrasie van die oplossing, mits die temperatuur konstant bly.✓✓ (2)

7.4.2 Conductivity ✓/*Geleidingsvermoë* ✓
Accept/*Aanvaar*: Ammeter reading/ *Ammeter lesing* (1)

7.4.3 Concentration (of the $AgNO_3$ solution) ✓
Konsentrasie (van die $AgNO_3$ oplossing) ✓
Accept/*Aanvaar*: Spoons of $AgNO_3$ in distilled water/ *Lepels $AgNO_3$ in gedistilleerde water.* (1)

7.4.4 Temperature ✓/*Temperatuur* ✓ (1)

7.5 Without water ✓/*Sonder water/Watervry*. ✓ (1)

7.6 Mass of $AgNO_3$ = (5,3)(2)
= 10,6 g ✓

$$c = \frac{m}{MV} \quad ✓$$
$$= \frac{10,6}{170(0,2)} \quad ✓$$
$$= 0,31 \text{ mol} \cdot \text{dm}^{-3} \quad ✓$$ (4)

7.7 No. ✓ Tap water contains ions and it will affect the conductivity of the $AgNO_3$ solution. ✓
Nee, ✓ *Die kraanwater sal die geleidingsvermoë van die $AgNO_3$ oplossing beïnvloed.* ✓ (2)

7.8 An increase in concentration of ions in a solution increases conductivity of a solution. ✓✓
Met 'n toename in konsentrasie van ione, neem die geleidingsvermoë toe. ✓✓ (2)

7.9.1 DECREASE ✓/*AFNEEM* ✓ (1)

7.9.2 Silver chloride precipitate forms/ a reaction takes place ✓, thus decreasing the concentration of the ions in the solution.✓
Daar vorm 'n silwerchloried neerslag/'n chemiese reaksie vind plaas ✓ wat die konsentrasie van die ione in oplossing laat afneem.✓ (2)
[22]

QUESTION 8/*VRAAG 8*

8.1 $BaCl_2$✓ (1)

8.2 $CO_3^{-2}(aq) + BaCl_2(aq)$ ✓ → $BaCO_3(s)$✓ + $2Cl^-(aq)$ ✓ Bal ✓
NOTE/*NOTA*: Phases need not be shown/ *Fases kan uitgelaat word* (4)

8.3 $BaCO_3(s) + HNO_3(aq)$ ✓ → $Ba(NO_3)_2(aq) + CO_2(g)$✓ + $H_2O(l)$✓ Bal ✓
NOTE/*NOTA*: Phases need not be shown/ *Fases kan uitgelaat word* (4)

8.4 Barium carbonate ✓✓/*Bariumkarbonaat*. ✓✓ (2)
[11]

QUESTION 7/*VRAAG 7*

7.1 An electrolyte is a solution that conducts electricity ✓✓through the movement of ions.
'n Elektroliet is 'n oplossing wat elektrisiteit gelei deur die beweging van ione. (2)

7.2 $KC\ell$ ✓ $\rightarrow K^+$ ✓ + $C\ell^-$ ✓ (3)

7.3 $KC\ell : K^+$
1 : 1
Thus 2 mol of $KC\ell$ dissolves.✓✓
Dus 2 mol $KC\ell$ los op. (2)

7.4 $\%K = \frac{39}{74,5} \times 100$ ✓
$= 52,35\%$ ✓ (2)

7.5 Increase ✓/*Toeneem* (1)

7.6 **NEGATIVE MARKING FROM QUESTION 7.5.**
NEGATIEWE NASIEN VAN VRAAG 7.5.
With an increase in concentration of the metal salt, potassium chloride, more ions are released ✓ into the solution. Thus, more free ions are available to conduct electricity. ✓
Met 'n toename in die konsentrasie van die metaalsout, kaliumchloried, word meer ione in die oplossing vrygelaat. Dus is meer ione beskikbaar om elektrisiteit te gelei. (2)
[12]

QUESTION 8/*VRAAG 8*

8.1 8.1.1 The empirical formula is the simplest whole number ratio of atoms in a compound. ✓✓
Die empiriese formule is die eenvoudigste heelgetalverhouding van atome in 'n verbinding. (2)

8.1.2 If 100 g of the compound is available then:
Indien 100 g van die verbinding beskikbaar is, dan is daar:

53,3 g O	40 g C	6,6 g H
$M(O) = 16\ g\cdot mol^{-1}$	$M(C) = 12\ g\cdot mol^{-1}$	$M(H) = 1\ g\cdot mol^{-1}$
$n = m/M$	$n = m/M$	$n = m/M$
$n = 53,3/16$	$n = 40/12$	$n = 6,6/1$
$n = 3,33125\ mol$ ✓	$n = 3,3\ mol$ ✓	$n = 6,6\ mol$ ✓

Thus/*Dus*:

O	:	C	:	H
3,33125	:	3,3	:	6,6
3,3		3,3		3,3 ✓
1	:	1	:	2

Emiprical formula/*Empiriese formule* = $C\ H_2\ O$✓
ACCEPT TABLE METHOD
AANVAAR TABEL METODE (5)

8.1.3 $M(CH_2O)$
$= 12 + 2(1) + 16$
$= 30\ g\cdot mol^{-1}$ ✓

$$\frac{\text{Formule mass/}\textit{Formulemassa}}{\text{Empirical mass/}\textit{Empiriese massa}} = \frac{60}{30} = 2\ ✓$$

Thus the *molecular formula*
Dus is die molekulêre formule $= (CH_2O) \times 2$
$= C_2H_4O_2$ ✓ (3)

8.2 $M\ (Na_2CO_3) = 106\ g\cdot mol^{-1}$ ✓

$M\ (x\ H_2O) = 268 - 106$
$= 162\ g\cdot mol^{-1}$ ✓

$$n(H_2O) = \frac{162}{18}\ ✓$$
$= 9\ mol$✓

(4)
[14]

Reaksies in waterige oplossing, Kwantitatiewe Aspekte Memo
November 2016/3

QUESTION 9/*VRAAG 9*

9.1 Temperature/*Temperatuur*: 273 K or/*of* 0 °C ✓
Pressure/*Druk*: 1,013 x 10^5 Pa (101,3 kPa) or/*of* 1 atm ✓ (2)

9.2 9.2.1

MARK OPTION 1 AND 2 IF 10g Na IS USED. ***MERK OPSIE 1 EN 2 INDIEN 10g Na GEBRUIK IS.***	**MARK OPTION 3 IF $2dm^3$ WATER IS USED** ***MERK OPSIE 3 INDIEN $2dm^3$ WATER GEBRUIK IS.***
OPTION 1/*OPSIE 1*: $n(Na) = \frac{m}{M}$ ✓ $= \frac{10}{23}$ ✓ = 0,43 mol Na Na : H_2 2 : 1 ✓ Thus 0,22 mol H_2 produced ✓ *Dus 0,22 mol H_2 word geproduseer.* $n(H_2) = \frac{m}{M}$ $0,22 = \frac{m}{2}$ m = 0,43 g ✓ H_2 produced/*gevorm* **OPTION 2/*OPSIE 2*:** 2 mol Na produces 1 mol H_2 ✓ (2)(23g) ✓ produces (1)(2g) ✓ 10g produces *x*✓ *x* = 0,43g✓	**OPTION 3/*OPSIE 3*:** 2 mol H_2O : 1 mol H_2 ✓ (2)(18) ✓ : 2 ✓ 2000 g : *x*✓ *x* = 111,11g ✓

(5)

9.2.2

POSITIVE MARKING FROM 9.2.1
POSITIEWE NASIEN VAN 9.2.1

MARK OPTION 1 AND 2 IF 10 g Na IS USED.
MERK OPSIE 1 EN 2 INDIEN 10g Na GEBRUIK IS.

OPTION 1/*OPSIE1*:

$n(H_2) = \frac{V}{V_m}$ ✓

$0,22 = \frac{V}{22,4}$ ✓

$V = 4,93\ dm^3$ ✓

Accept $4,82\ dm^3$

OPTION 2/*OPSIE 2*:

1 mol : $22,4\ dm^3$ ✓
2g : $22,4\ dm^3$✓
0,43g : x
$x = 4,82\ dm^3$✓

MARK OPTION 3 IF $2dm^3$ WATER IS USED
MERK OPSIE 3 INDIEN $2dm^3$ WATER GEBRUIK IS.

OPTION 3/*OPSIE 3*:

1 mol : $22,4\ dm^3$ ✓
2g : $22,4\ dm^3$✓
111,11g : x
$x = 1244,43\ dm^3$

(3)

9.2.3

POSITIVE MARKING FROM 9.2.1
POSITIEWE NASIEN VAN 9.2.1

MARK OPTION 1 AND 2 IF 10 g Na IS USED.
MERK OPSIE 1 EN 2 INDIEN 10g Na GEBRUIK IS.

OPTION 1/*OPSIE 1*:

n(Na) : n(NaOH)
2 : 2 ✓
Thus mol NaOH = 0,43 mol
Dus mol NaOH = 0,43 mol

$n(NaOH) = \frac{m}{M}$ ✓

$0,43 = \frac{m}{(23+16+1)}$ ✓
m = 17,2 g ✓ of NaOH produced/*gevorm*

OPTION 2/*OPSIE 2*:

1 mol Na produces/*produseer* 1 mol NaOH ✓
23g produces/*produseer* 40g ✓
10g produces/*produseer* *x*✓
x = 17,39g✓

MARK OPTION 3 IF 2dm^3 WATER IS USED
MERK OPSIE 3 INDIEN 2dm^3 WATER GEBRUIK IS.

OPTION 3/*OPSIE 3*:

1 mol H_2O : 1 mol NaOH ✓
18g : 40g ✓
2000g : *x*✓
x = 4444,44g✓

(4)

9.2.4

POSITIVE MARKING FROM 9.2.3
POSITIEWE NASIEN VAN 9.2.3

$c = \frac{n}{V}$ ✓

$c = \frac{0,43}{2}$ ✓

c = 0,22 mol.dm^{-3} ✓

(3)
[14]

Reaksies in waterige oplossing, Kwantitatiewe Aspekte Memo
November 2016/6

QUESTION 10/*VRAAG 10*

10.1		Precipitate ✓/*Presipitaat/Neerslag*	(1)
10.2	10.2.1	Step I: $BaCl_2$ ✓ Step II: no reaction ✓ *Stap I: $BaCl_2$* *Stap II: geen reaksie* ✓	(2)
	10.2.2	Step I: $AgNO_3$ ✓ Step II: HNO_3 ✓ *Stap I: $AgNO_3$* *Stap II: HNO_3*	(2)
	10.2.3	White ✓/*Wit*	(1)

1.8 B ✓✓ (2)

1.9 B ✓✓ (2)

1.10 C ✓✓ (2)

QUESTION 7/*VRAAG 7*

7.1 Reaction in which a proton/hydrogen ion/H^+ is transferred from one reactant to another. ✓✓
Reaksie waarin 'n proton/waterstofioon/H^+ oorgedra word van een reaktans na 'n ander. (2)

7.2 18 cm^3 ✓ (1)

7.3

7.3.1 Number of moles of solute ✓ per cubic decimetre/litre of solution. ✓
Aantal mol opgeloste stof per kubieke desimeter/liter oplossing. (2)

7.3.2
$$\%CaCO_3 = \frac{0,1✓}{0,25} \times 100 ✓$$
$$= 40\% \ ✓$$
(3)

7.3.3 **POSITIVE MARKING FROM QUESTION 7.3.2 i.e. 0,1 g FROM GRAPH.**
POSITIEWE NASIEN VANAF VRAAG 7.3.2, m.a.w. 0,1 g VAN DIE GRAFIEK.

$$n(CaCO_3) = \frac{m}{M}$$
$$= \frac{0,1}{100}✓$$
$$= 1 \times 10^{-3} mol$$

$n(HCℓ) = 2 \times n(CaCO_3) = 2 \times 10^{-3}$ mol ✓

Volume acid/*volume suur*:

$c = \frac{n}{V}$ ✓

$0,1 = \frac{2 \times 10^{-3}}{V}$ ✓

$V = 0,02\ dm^3$ ✓ (5)

[13]

QUESTION 8/*VRAAG 8*

8.1 Solution in which the solvent is water. ✓
Oplossing waarin die oplosmiddel water is. (1)

8.2

8.2.1 The process in which solid ionic crystals are broken up into ions ✓when dissolved in water. ✓
Die proses waarin vaste ioniese kristalle opgebreek word in ione wanneer opgelos word in water. (2)

8.2.2 $(NH_4)_2CO_3(s)$ ✓→ $2NH_4^+(aq) + CO_3^{2-}(aq)$ ✓ bal. ✓ (3)

Notes/*Aantekeninge*
- Reactants ✓ Products ✓ Balancing ✓
  Reaktanse ✓ *Produkte* ✓ *Balansering* ✓
- Ignore/*Ignoreer* ⇌ and phases/*en fases.*
- Marking rule 3.10/*Nasienreël 3.10*

8.3

8.3.1 (a) Conductivity/Ammeter reading ✓
Geleidingsvermoë/Ammeterlesing (1)

(b) Type of compound/Concentration of ions ✓
Tipe verbinding/Konsentrasie van ione (1)

8.3.2 An increase in ion concentration increases the conductivity. ✓
'n Toename in ioonkonsentrasie verhoog die geleidingsvermoë. (1)

8.3.3 $NaCl \rightarrow Na^+ + Cl^-$ ✓
Forms two ions per mole of NaCl./*Vorm twee ione per mol* NaCl. ✓
$CaCl_2 \rightarrow Ca^{2+} + 2Cl^-$ ✓
Forms three ions per mole of $CaCl_2$./Vorm *drie ione per mol* $CaCl_2$. ✓

OR/*OF*
Concentration of ions in $CaCl_2(aq)$ is higher than in $NaCl(aq)$. ✓✓
Konsentrasie van ione in $CaCl_2(aq)$ is hoër as in $NaCl(aq)$. (4)

8.4

8.4.1 Redox/*Redoks* ✓ (1)

8.4.2 Gas forming/*Gasvorming* ✓ (1)

8.4.3 Precipitation/*Presipitasie* ✓ (1)

8.5 $Cu + 4HNO_3$ ✓ → $Cu(NO_3)_2 + 2H_2O + 2NO_2$ ✓ Bal. ✓

Notes/*Aantekeninge*
- Reactants ✓ Products ✓ Balancing ✓
  Reaktanse ✓ *Produkte* ✓ *Balansering* ✓
- Ignore/*Ignoreer* ⇌
- Marking rule 3.10/*Nasienreël 3.10*

(3)
[19]

Reaksies in waterige oplossing, Kwantitatiewe Aspekte Memo
November 2015/3

QUESTION 9/*VRAAG 9*

9.1

9.1.1 One mole is the amount of substance ✓ having the same number of particles as there are atoms in 12 g carbon-12. ✓
Een mol is die hoeveelheid stof wat dieselfde aantal deeltjies bevat as wat daar atome is in 12 g koolstof-12. (2)

9.1.2 0,67 mol/$\frac{2}{3}$ mol ✓ (1)

9.1.3 $V(N_2) : V(H_2) : V(NH_3) = 1 : 3 : 2$

$V(N_2 \text{ reacted/}reageer) = \frac{1}{3}V(H_2)$

$= \frac{1}{3}(24)$ ✓

$= 8 \text{ dm}^3$

Volume N_2 remains/*oorbly* = 10 – 8 ✓ = 2 dm^3

Volume of gas that remains/*Volume gas wat oorbly* = 2 + 16 ✓

= 18 dm^3 gas ✓ (4)

9.1.4 $n = \frac{m}{M}$

$= \frac{80}{2}$ ✓

$= 40 \text{ mol}$ ✓ (2)

9.1.5 $V(N_2) = \frac{1}{3}(40) \times 22,4$ ✓

$= 298,67 \text{ dm}^3$ ✓ (2)

9.2 $m(O_2) = 239 - 207 = 32 \text{ g}$ ✓

$n(Pb) = \frac{m}{M}$

$= \frac{207}{207}$ ✓

$= 1 \text{ mol}$

$n(O) = \frac{m}{M}$

$= \frac{32}{16}$ ✓

$= 2 \text{ mol}$

n(Pb) : n(O)

1 : 2 ✓

∴ PbO_2 ✓ (5)

[16]

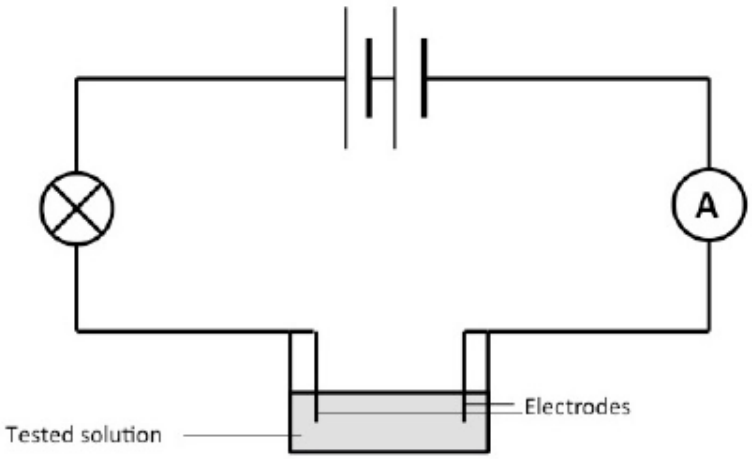
Science Clinic 1

8.1. Substance must contain charge carriers
Charge carriers must be free to move

8.2.

Substance	Prediction	Reason
Water - distilled	No	No ions
Water – tap	Yes	There are some ions to carry the charge, which are free to move
Copper wire	Yes	There are some electrons to carry the charge, which are free to move
NaCl in aqueous solution	Yes	There are some ions to carry the charge, which are free to move
Xylene –	No	No ions
Sulphur	No	No ions

8.3.



8.4. There are ions in the ionic solution. These ions are free to move. The negative ions will be attracted to the positive electrode on the left and the positive ions will be attracted to the negative electrode on the right. The circuit will be complete.

8.5.

8.5.1. IV = concentrations of the solutions.
DV = current through each solution.

8.5.2. The distance between the electrodes and the voltage applied was kept constant.

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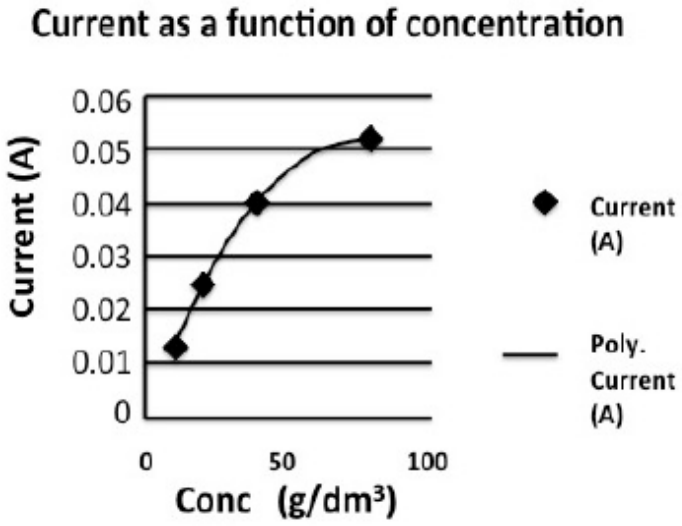
8.5.3.

Data	Conc / [g dm^{-3}]	Current /[A]
1	10	0,013
2	20	0,025
3	40	0,040
4	80	0,051

8.5.4.



8.5.5. The graph shows that as the concentration increases, so does the current – however, the concentration and current is not directly proportional.

8.5.6. $MgCl_2(s) \rightarrow Mg^{2+}(aq) + 2Cl^-(aq)$

8.6.

8.6.1. $2\ Mg(s) + O_2(g) \rightarrow 2\ MgO(s)$

8.6.2. B: The iodide ions have been exchanged for the chloride ions.

8.6.3. A: Each Mg atoms have lost 2 electrons, one to each of the Cl atoms.

8.6.4. Acidify with Dilute HNO_3 Add a few drops of Ag NO_3.
White precipitate indicates Chloride ions are present. (AgCl has formed)

8.7.

8.7.1. $PbCl_2$, white

8.7.2. $CaCO_3$, white

8.7.3. AgBr, cream

8.8. No her conclusion is incorrect. Ammonium carbonate is soluble, but carbonate is insoluble with other ions. Tap water contains other ions that will form a low

concertation precipitate leaving the solution murky.

8.9. There was a precipitation reaction that took place, the precipitation is most likely head iodide

$I^-_{(aq)} + Pb^{+2}_{(aq)} \rightarrow PbI_{2(s)}$

8.10. Mixture A. Mixture B will form a precipitate which lowers the concentration of free ions in the solution.

QUANTITATIVE ASPECTS OF CHEMICAL CHANGE

EXAM LEVEL QUESTIONS

9.1.

9.1.1. Percent by mass of NITROGEN present in ammonium phosphate $[(NH_4)_3PO_4]$.
% by mass = 3 nitrogen atoms / $[(NH_4)_3PO_4]$ x 100 = 3 x 14 / (149) x 100 = 28,19 %

9.1.2. Molar mass of hexane (C_6H_{14}) = 72 + 14 = 86 g mol^{-1}

9.1.3. Moles of hexane are there in 4,3g: n = m / M = 0,05 mol
Molecules of hexane are there in 4,3g = 0,05 x 6,02 x 10^{23} = 3,01 x 10^{22}

9.2. 29,0% sodium, 40,5% sulphur, and 30,4 % oxygen by weight.

	Na	S	O
Mass	29	40,5	30,4
M	23	32	16
n	1,26	1,26	1,9
Ratio	1	1	1,5
Whole numbers	2	2	3

Formula is $Na_2S_2O_3$

9.3.

9.3.1. number of moles of Li_2CO_3 = m / M = 5 / (14+12+48) = 0,068 mol

9.3.2. concentration of solution = n / V = 0,068 / 0,1 = 0,68 $mol.dm^{-3}$

9.4.

9.4.1. $2\ Na + Cl_2 \rightarrow 2\ NaCl$

9.4.2. 2 mol Na form 2 mol NaCl. Mass = n x M = 2 x 58,5 = 117g

9.4.3. 1 mol Cl_2 required = 71g

9.4.4. 2,5 mol of sodium reacts with 1.25 mol Cl_2 volume of Cl_2 = 1,25 x 22,4 = $28dm^3$

Science Clinic 4

9.5. magnesium + hydrochloric acid → magnesium chloride + hydrogen gas

$Mg(s) + 2\,HCl\,(aq) \rightarrow MgCl_2\,(aq) + H_2\,(g)$

n.(hydrochloric acid) = 14,6 g / 36,5 = 0,4mol

n.(hydrogen gas) = 0,2 mol

volume of hydrogen gas = 0,2 x 22,4 = 4,48 dm^3.

9.6.

9.6.1. It indicates that the manganese ion will be a 4+ ion OR it indicates that the oxidation state of the manganese is 4+.

9.6.2. $4Al + 3MnO_2 \rightarrow 2Al_2O_3 + 3Mn$

9.6.3. The (total) mass of the reactants of a chemical reaction is equal to the (total) mass of the products of the reaction.

9.6.4. $M_r(\text{reactants}) = 4(27) + 3(55 + (16\times2))$

$= 369$

$M_r(\text{products}) = 2((27\times2) + (16\times3)) + (3\times55)$

$= 369$

$M_r(\text{reactants}) = M_r(\text{products})$

Law of Conservation of Mass is valid

9.7.

9.7.1. An acid-base reaction is a reaction that takes place between acids and bases.

9.7.2. $17cm^3$

9.7.3.

9.7.3.1. The concentration of a solution is the amount of solute per unit volume of solution.

9.7.3.2. $30cm^3 = 0,12g$

% $CaCO_3$ in antacid tablet= $\frac{0,12}{0,5}\times100 = 24\%$

9.7.3.3. $n(CaCO_3) = \frac{m}{M}$

$= \frac{0,12}{100}$

$= 1,2\times10^{-3}\ mol$

$CaCO_3 : HCl$

$1 : 2$

$1,2\times10^{-3} : 2,4\times10^{-3}$

Science Clinic 5

$$c = \frac{n}{V}$$
$$0{,}15 = \frac{2{,}4\times10^{-3}}{V}$$
$$V = \frac{2{,}4\times10^{-3}}{0{,}15}$$
$$V = 0{,}016dm^3$$
$$\therefore = 16mL$$

9.8.

9.8.1. The number of particles or atoms as in 12,0g of carbon-12

9.8.2. $H_2 : NH_3$

$3:2$

$\therefore n(NH_3) = 2mol$

9.8.3. *Hydrogen is the limiting reactant*

number of moles N_2 *used*:

$H_2 : N_2$

$3:1$

$30:10$

$\therefore$ *amount of* N_2*remaining* $= 5cm^3$

number of moles of NH_3:

$H_2 : NH_3$

$3:2$

$30:20$

$\therefore$ *amount of* NH_3*produced* $= 20cm^3$

Volume remaining $= 5 + 20 = 25cm^3$

Science Clinic 6

9.8.4. $n(H_2) = \frac{m}{M}$

$= \frac{80}{2}$

$= 40mol$

$H_2 : N_2$

$3 : 1$

$2{,}86 : 0{,}96$

$\therefore n(N_2) = 0{,}95mol$

9.8.5. $n = \frac{V}{V_M}$

$0{,}95 = \frac{V}{22{,}4}$

$(0{,}95)(22{,}4) = V$

$V = 21{,}28dm^3$

9.9.

9.9.1. $Na_2S_2O_3(s) + 2HCl(aq) \rightarrow 2NaCl(aq) + S(s) + SO_2(g) + H_2O(l)$

9.9.2. $n(HCl) = cV$

$= (0{,}15)(0{,}4)$

$= 0{,}06mol$

9.9.3.

9.9.3.1. $HCl : SO_2$

$2 : 1$

$0{,}06 : 0{,}03$

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

$0{,}03 = \frac{V}{22{,}4}$

$V = (0{,}06)(22{,}4)$

$V = 0{,}672dm^3$

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9.9.3.2. $HCl : S$

$2 : 1$

$0{,}06 : 0{,}03$

$$n = \frac{m}{M}$$
$$0{,}03 = \frac{m}{32}$$
$$(0{,}03)(32) = m$$
$$m = 0{,}96g$$

9.9.3.3. $HCl : NaCl$

$2 : 2$

$0{,}060{,}06$

$$c = \frac{n}{V}$$
$$c = \frac{0{,}06}{0{,}4}$$
$$c = {,}15mol \cdot dm^{-3}$$

9.9.4. $n(S) = \frac{m}{M}$

$= \frac{50}{32}$

$= 1{,}56mol$

$S : Na_2S_2O_3$

$1 : 1$

$1{,}56 : 1{,}56$

$$n = \frac{m}{M}$$
$$1{,}56 = \frac{m}{158}$$
$$m = (1{,}56)(158)$$
$$m = 246{,}48g$$

9.10.

9.10.1. $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4$□$_2O\ (l)$

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9.10.2.

9.10.2.1. $$n(C_3H_8) = \frac{m}{M}$$
$$= \frac{9,48}{44}$$
$$= 0,22mol$$

$$no.of\ particles = nN_A$$
$$= (0,22)(6,02\times10^{23})$$
$$= 1,32\times10^{23}\ particles$$

9.10.2.2. $C_3H_8 : O_2$

$1 : 5$

$0,22 : 1,1$

$$n = \frac{V}{V_M}$$
$$1,1 = \frac{V}{22,4}$$
$$V = 24,64dm^3$$

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9.10.2.3.

$$C_3H_8 : CO_2 : H_2O$$

$$1 : 3 : 4$$

$$0{,}22 : 0{,}66 : 0{,}88$$

$$CO_2 :$$

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

$$0{,}66 = \frac{m}{44}$$

$$m = (0{,}66)(44)$$

$$29{,}04g$$

$$H_2O :$$

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

$$0{,}88 = \frac{m}{18}$$

$$m = (0{,}88)(18)$$

$$m = 15{,}84g$$

$$Total\ mass = 29{,}04 + 15{,}84 = 44{,}88g$$