

Reaksies in waterige oplossing, Kwantitatiewe Aspekte
November 2018/1

- 1.8 Een mol H_2SO_4 bevat ...
- A 7 atome.
 - B 1 molekule.
 - C $6,02 \times 10^{23}$ molekule.
 - D $42,14 \times 10^{23}$ molekule. (2)
- 1.9 Watter EEN van die volgende oplossings sal NIE 'n neerslag vorm as dit by 'n oplossing silwernitrat gevoeg word NIE?
- A NaCl(aq)
 - B $\text{MgBr}_2\text{(aq)}$
 - C KI(aq)
 - D $\text{Mg(NO}_3)_2\text{(aq)}$ (2)

VRAAG 7 (Begin op 'n nuwe bladsy.)

'n Groep leerders berei 'n $0,25 \text{ mol} \cdot \text{dm}^{-3}$ -oplossing natriumkarbonaat deur 'n 14,2 g-monster gehidrateerde natriumkarbonaat ($\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$) in 200 cm^3 water op te los.

- 7.1 Verduidelik die betekenis van die term *gehidrateer*. (1)
- 7.2 Skryf 'n GEBALANSEERDE CHEMIESE VERGELYKING neer om te toon hoe natriumkarbonaat in water dissosieer (ontbind). (2)
- 7.3 Leerders neem dan 10 cm^3 van die bereide oplossing en laat dit volledig met 5 cm^3 verdunde soutsuur reageer, volgens die volgende gebalanseerde chemiese vergelyking:
- $$\text{Na}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$$
- 7.3.1 Definieer die term 'n mol van 'n stof. (2)
- 7.3.2 Watter tipe chemiese reaksie word deur die chemiese vergelyking hierbo verteenwoordig? (1)
- 7.3.3 Bereken die getal mol soutsuur in 5 cm^3 soutsuur indien die konsentrasie daarvan $1 \text{ mol} \cdot \text{dm}^{-3}$ is. (3)
- 7.4 Bereken die massa natriumchloried wat in die reaksie in VRAAG 7.3 gevorm word. (5)

VRAAG 8 (Begin op 'n nuwe bladsy.)

Leerders ondersoek hoe die tipe stof die elektriese geleidingsvermoë van die stof beïnvloed. Hulle voer drie eksperimente onder dieselfde toestande met drie verskillende stowwe uit, soos in die tabel hieronder getoon.

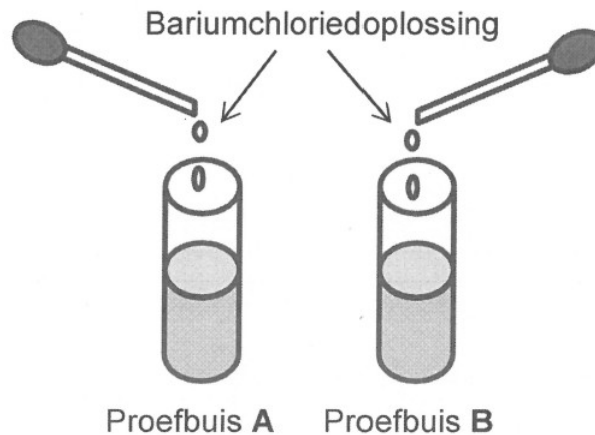
EKSPERIMENT	MASSA VAN STOF (g)	TIPE STOF	TEMPERATUUR (°C)
1	2	Oplossing van CaCl_2	25
2	2	Oplossing van KCl	25
3	2	Oplossing van suiker	25

- 8.1 Definieer die term *elektroliet*. (2)
- 8.2 Vir die ondersoek, skryf neer die:
- 8.2.1 Ondersoekende vraag (2)
- 8.2.2 Afhanklike veranderlike (1)
- 8.2.3 Onafhanklike veranderlike (1)
- 8.2.4 Beheerde veranderlike (1)
- 8.3 Vir die ondersoek, voorspel met redes die stof wat die volgende sal lewer:
- 8.3.1 Die hoogste geleidingsvermoë (2)
- 8.3.2 Nul geleidingsvermoë (2)
- 8.4 Die stof wat in Eksperiment 3 getoets is, is ontleed. Daar is gevind dat dit 40% koolstof, 6,67% waterstof en 53,33% suurstof bevat.
- Bepaal die molekulêre formule indien die molêre massa $180 \text{ g}\cdot\text{mol}^{-1}$ is. (7)

[18]

VRAAG 9 (Begin op 'n nuwe bladsy.)

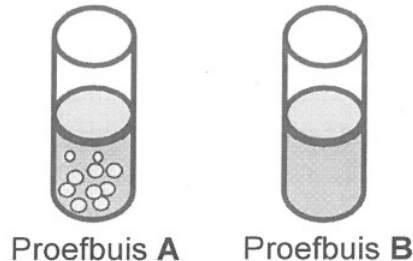
Twee proefbuis, **A** en **B**, bevat beide 'n natriumsoutoplossing. Nadat 'n klein hoeveelheid bariumchloried bygevoeg is, vorm die oplossing in beide proefbuis 'n wit neerslag.



9.1 Skryf die tipe reaksie wat in die proefbuis plaasvind, neer. (1)

9.2 'n Gekonsentreerde salpetersuuroplossing word dan by elke proefbuis gevoeg om vas te stel watter een karbonaat-ione en watter een sulfaat-ione bevat.

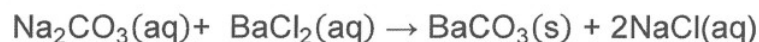
Borrels word in proefbuis **A** gevorm. Daar is geen reaksie in proefbuis **B** nie.



9.2.1 Identifiseer watter IONE (KARBONAAT of SULFAAT) in proefbuis **B** teenwoordig is. (1)

9.2.2 Skryf 'n GEBALANSEERDE CHEMIESE VERGELYKING neer wat die reaksie tussen salpetersuur en die neerslag wat in proefbuis **A** gevorm het, verteenwoordig. (3)

9.3 'n Oplossing natriumkarbonaat is berei deur 5 g van die poeier in 100 cm³ water op te los. Die oplossing het met 'n bariumchloriedoplossing gereageer, volgens die volgende gebalanseerde chemiese vergelyking:



9.3.1 Bereken die massa bariumkarbonaat wat in hierdie reaksie behoort te vorm. (5)

Daar is gevind dat slegs 8,3 g neerslag gevorm het.

9.3.2 Bereken die persentasie opbrengs. (2)

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- 1.7 In 'n 20 g-monster van molekule, watter monster hieronder het die grootste getal mol?

A NH_3

B N_2

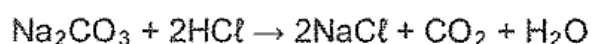
C CO_2

D H_2

(2)

VRAAG 6 (Begin op 'n nuwe bladsy.)

- 6.1 Bestudeer die gebalanseerde chemiese vergelyking van die reaksie tussen natriumkarbonaat (Na_2CO_3) en soutsuur (HCl) en beantwoord die vrae wat volg.



Identifiseer die soort reaksie hierbo. Kies tussen REDOKS en GASVORMEND.

(1)

- 6.2 In 'n reaksie reageer 10,6 g natriumkarbonaat volledig met 'n oormaat soutsuur.

6.2.1 Bereken die molêre massa van natriumkarbonaat.

(2)

6.2.2 Bereken die aanvanklike getal mol natriumkarbonaat.

(2)

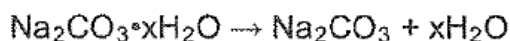
6.2.3 Bereken die massa CO_2 wat gedurende hierdie reaksie gevorm word.

(4)

6.2.4 Bereken die massa natriumchloried wat gevorm word indien $4,87 \text{ dm}^3$ koolstofdioksied by STD gevorm is.

(6)

- 6.3 14,2 g van 'n monster gehidrateerde natriumkarbonaat, $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$, is sterk verhit totdat geen verdere verandering in massa aangeteken is nie. Al die kristalwater het soos volg by verhitting verdamp:



Bereken die getal mol kristalwater in die natriumkarbonaatmonster, indien 5,3 g vaste stof na sterk verhitting oorgebly het.

(5)

[20]

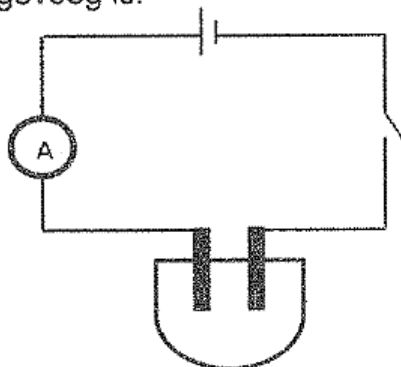
Reaksies in waterige oplossing, Kwantitatiewe Aspekte

November 2017/2

VRAAG 7 (Begin op 'n nuwe bladsy.)

Leerders het die verwantskap tussen die konsentrasie van 'n silwernitraat(AgNO_3)-oplossing en die geleidingsvermoë daarvan by 'n konstante temperatuur ondersoek.

Hulle het die apparaat opgestel, soos hieronder getoon, en die stroom(sterkte) aangeteken. Die aanvanklike lesing op die ammeter is geneem voordat anhidriese AgNO_3 by gedistilleerde water gevoeg is.



Die anhidriese AgNO_3 is lepel vir lepel by 200 cm^3 gedistilleerde water gevoeg. Die ammeterlesing is geneem nadat elke lepel bygevoeg is. Die resultate word in die tabel hieronder getoon.

LEPELS AgNO_3 IN GEDISTILLEERDE WATER	AMMETERLESING (mA)
0	0
1	0,18
2	0,92
3	1,47
4	1,84

- 7.1 Gee 'n rede waarom die aanvanklike ammeterlesing nul was. (1)
- 7.2 Gee EEN woord/term vir 'n oplossing wat elektrisiteit gelei. (2)
- 7.3 Skryf 'n gebalanseerde chemiese vergelyking neer om te toon hoe AgNO_3 in water dissosieer. (2)
- 7.4 Skryf die volgende vir die ondersoek hierbo neer:
- 7.4.1 'n Hipotese (2)
- 7.4.2 Afhanklike veranderlike (1)
- 7.4.3 Onafhanklike veranderlike (1)
- 7.4.4 Gekontroleerde veranderlike (1)
- 7.5 Definieer die term *anhidries*. (1)
- 7.6 Indien die massa AgNO_3 5,3 g per lepel is, bereken die konsentrasie van die oplossing nadat TWEE lepels bygevoeg is. (4)

Reaksies in waterige oplossing, Kwantitatiewe Aspekte

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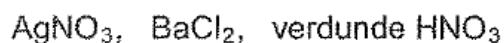
- 7.7 Kan kraanwater vir hierdie eksperiment gebruik word? Gee 'n rede vir die antwoord. (2)
- 7.8 Lei 'n verwantskap af uit die resultate tussen die ioonkonsentrasie in die oplossing en die geleidingsvermoë daarvan. (2)
- 7.9 'n Leerder het per ongeluk soutsuur in die oplossing laat val.
- 7.9.1 Hoe sal dit die ammeterlesing beïnvloed? Skryf slegs TOENEEM, AFNEEM of BLY DIESELFDE neer. (1)
- 7.9.2 Verduidelik die antwoord op VRAAG 7.9.1. (2)

[22]

VRAAG 8 (Begin op 'n nuwe bladsy.)

Jou onderwyser het jou gevra om jou kennis van neerslagreaksies te gebruik om die watergehalte in die plaaslike rivier te toets.

Jy word van die volgende chemikalieë voorsien:



- 8.1 Watter chemikalie sal jy kies om vir die teenwoordigheid van karbonate (CO_3^{2-}) te toets? (1)
- 8.2 Gebruik 'n gebalanseerde chemiese vergelyking om die toets vir karbonate in VRAAG 8.1 te toon. (4)
- 8.3 Beide karbonate en sulfate vorm 'n wit neerslag met die chemikalie in VRAAG 8.1.
- Gebruik 'n gebalanseerde chemiese vergelyking om te verduidelik hoe jy sou bevestig dat die neerslag 'n karbonaat is. (4)
- 8.4 Gee die chemiese naam van die neerslag wat gevorm word wanneer die karbonaat en die chemikalie in VRAAG 8.1 reageer. (2)

f111

VRAAG 7 (Begin op 'n nuwe bladsy.)

Kaliumchloried dissosieer in water om 'n elektroliet te vorm.

- 7.1 Definieer die term *elektroliet*. (2)
- 7.2 Gebruik 'n chemiese reaksie om aan te toon hoe kaliumchloried in water dissosieer. (3)
- 7.3 Indien 2 mol kalium-ione vorm gedurende die proses wat in VRAAG 7.2 gebruik is, hoeveel mol van die metaalsout het opgelos? (2)
- 7.4 Bereken die persentasie kalium in kaliumchloried. (2)
- 7.5 Hoe sal 'n toename in die konsentrasie van kaliumchloried die geleidingsvermoë van die elektroliet beïnvloed?
Skryf slegs TOENEEM, AFNEEM of BLY DIESELFDE neer. (1)
- 7.6 Gee 'n rede vir die antwoord op VRAAG 7.5. (2)
- [12]**

VRAAG 8 (Begin op 'n nuwe bladsy.)

8.1 Die empiriese formule van 'n sekere verbinding moet bepaal word. Gedurende 'n analise van 'n monster van die verbinding is daar gevind dat dit 40% C, 6,6% H en 53,3% O bevat.

8.1.1 Definieer die term *empiriese formule*. (2)

8.1.2 Bepaal die empiriese formule van die verbinding. Toon ALLE berekeninge. (5)

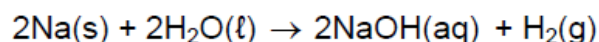
8.1.3 Indien die molekulêre massa van die verbinding $60 \text{ g}\cdot\text{mol}^{-1}$ is, bereken die molekulêre formule van die verbinding. (3)

8.2 Die molêre massa van gehidrateerde natriumkarbonaat is $268 \text{ g}\cdot\text{mol}^{-1}$. Die formule van die gehidrateerde natriumkarbonaat is $\text{Na}_2\text{CO}_3\cdot x\text{H}_2\text{O}$.

Bereken die getal mol kristallasiewater (x) in die verbinding. (4)
[14]

VRAAG 9 (Begin op 'n nuwe bladsy.)

Die reaksie tussen natrium en water word deur die volgende gebalanseerde chemiese reaksievergelyking voorgestel:



Gedurende hierdie reaksie reageer 10 g natrium met 2 dm^3 water om waterstofgas teen STD te produseer.

9.1 Skryf die waardes van temperatuur en druk by STD neer. (2)

9.2 Bereken die volgende:

9.2.1 Massa (in gram) waterstofgas geproduseer (5)

9.2.2 Volume (in dm^3) waterstofgas teen STD geproduseer (3)

9.2.3 Massa (in gram) NaOH geproduseer (4)

9.2.4 Konsentrasie van die natriumhidroksiedoplossing (3)
[17]

VRAAG 10 (Begin op 'n nuwe bladsy.)

Chloried-ione en sulfaat-ione kom in water voor. Hierdie ione kan geïdentifiseer word deur die *onoplosbare verbindings* wat hulle in chemiese reaksies vorm.

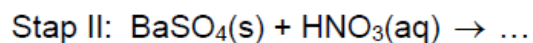
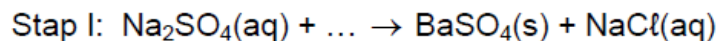
10.1 Skryf die korrekte term vir die volgende beskrywing neer:

Die *onoplosbare verbinding* wat gevorm word wanneer sekere oplossings reageer

(1)

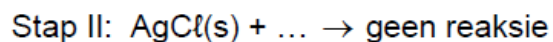
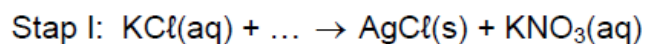
10.2 Voltooi die volgende reaksies deur die ontbrekende reagense/produkte, waar nodig, neer te skryf:

10.2.1 Toets vir sulfaat-ione:



(2)

10.2.2 Toets vir chloried-ione



(2)

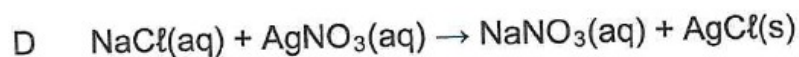
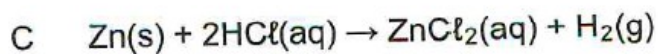
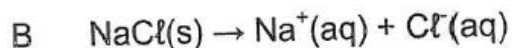
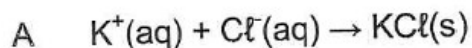
10.2.3 Watter kleur is die onoplosbare vaste stof wat in stap I van VRAAG 10.2.2 gevorm word?

(1)

Reaksies in waterige oplossing, Kwantitatiewe Aspekte

November 2015/1

1.8 Watter EEN van die volgende gebalanseerde vergelykings verteenwoordig 'n dissosiasieproses?



(2)

1.9 Watter EEN van die volgende verteenwoordig 1 mol van 'n stof?

A 16 g suurstofgas

B 2 g waterstofgas

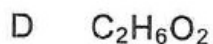
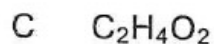
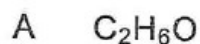
C 22,4 dm³ koper

D 22,4 cm³ stikstofgas

(2)

1.10 Die empiriese formule van 'n sekere koolstofverbinding is CH₂O.

Watter EEN van die volgende kan die molekulêre formule van die verbinding wees?



(2)

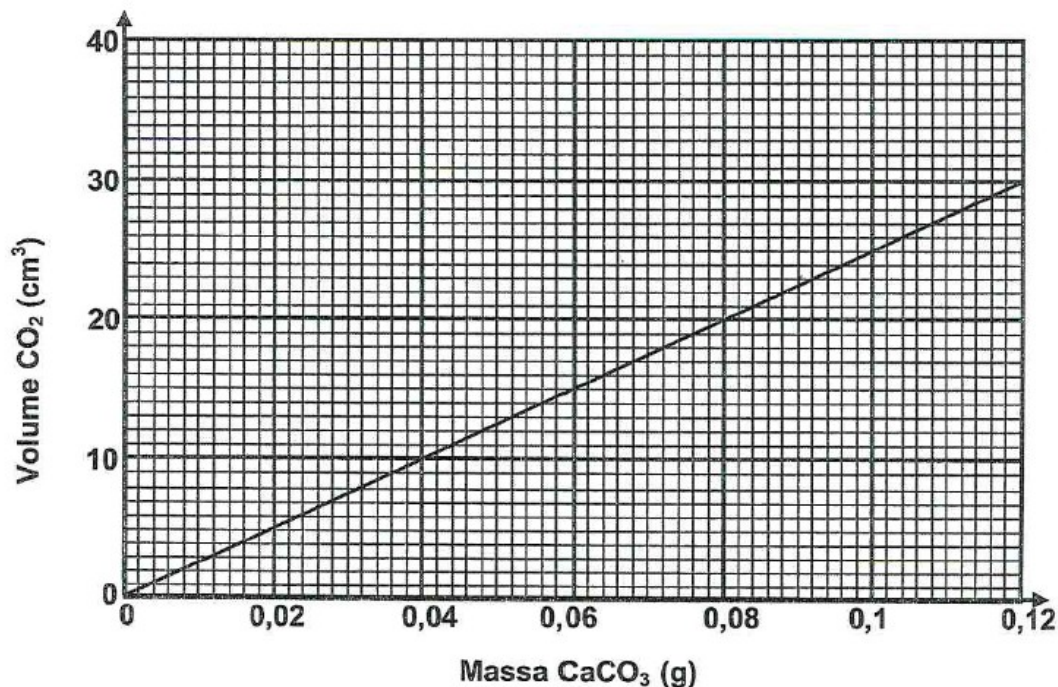
VRAAG 7 (Begin op 'n nuwe bladsy.)

Kalsiumkarbonaat, CaCO_3 , reageer met verdunde soutsuur, HCl , volgens die volgende gebalanseerde vergelyking:



- 7.1 Die reaksie hierbo is 'n voorbeeld van 'n suur-basis-reaksie. Definieer die term *suur-basis-reaksie*. (2)

Die grafiek hieronder toon die verwantskap tussen die volume koolstofdiksiedgas, $\text{CO}_2(\text{g})$, wat gevorm word en die massa SUIWER kalsiumkarbonaat.



- 7.2 Bepaal, vanaf die grafiek, die volume $\text{CO}_2(\text{g})$ wat gevorm word wanneer 0,072 g SUIWER $\text{CaCO}_3(\text{s})$ reageer. (1)

- 7.3 'n Sekere teensuurtablet, met 'n massa van 0,25 g, bevat hoofsaaklik kalsiumkarbonaat wat met verdunde soutsuur in die maag reageer om koolstofdiksiedgas te vorm.

Die konsentrasie soutsuur in die maag is $0,1 \text{ mol} \cdot \text{dm}^{-3}$.

- 7.3.1 Definieer die term *konsentrasie van 'n oplossing*. (2)

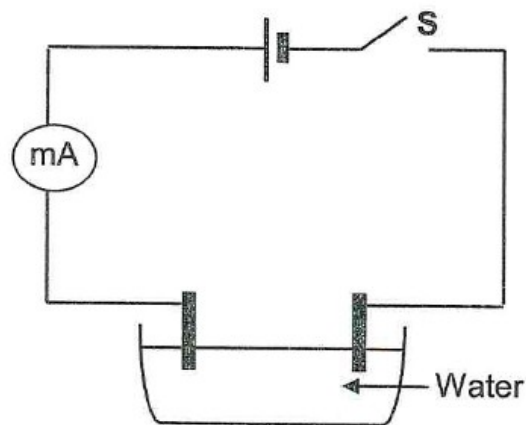
- 7.3.2 Daar word gevind dat $25 \text{ cm}^3 \text{ CO}_2(\text{g})$ gevorm word wanneer een teensuurtablet volledig reageer.

Gebruik die inligting in die grafiek en bereken die persentasie $\text{CaCO}_3(\text{s})$ in een teensuurtablet. (3)

- 7.3.3 Bereken die volume soutsuur wat deur EEN teensuurtablet geneutraliseer sal word. (5)

VRAAG 8 (Begin op 'n nuwe bladsy.)

- 8.1 Baie chemiese reaksies vind in waterige oplossings plaas. Definieer die term *waterige oplossing*. (1)
- 8.2 Ioniese vaste stowwe dissosieer wanneer dit in water oplos.
- 8.2.1 Definieer die term *dissosiasie*. (2)
- 8.2.2 Skryf 'n gebalanseerde vergelyking neer vir die dissosiasie van ammoniumkarbonaat, $(\text{NH}_4)_2\text{CO}_3$, in water. (3)
- 8.3 Die eksperimentele opstelling hieronder word gebruik om die elektriese geleidingsvermoë van 'n kalsiumchloriedoplossing, $\text{CaCl}_2(\text{aq})$, en 'n natriumchloriedoplossing, $\text{NaCl}(\text{aq})$, te vergelyk. Die konsentrasie van elke oplossing is $0,5 \text{ mol} \cdot \text{dm}^{-3}$.



Die $\text{CaCl}_2(\text{aq})$ word druppelgewys by water gevoeg en die ammeterlesing word aangeteken na die byvoeging van elke druppel. Die prosedure word dan herhaal met die $\text{NaCl}(\text{aq})$. Die resultate word in die tabel hieronder aangetoon.

GETAL DRUPPELS OPLOSSING	AMMETERLESING (mA)	
	$\text{CaCl}_2(\text{aq})$	$\text{NaCl}(\text{aq})$
0	0,18	0,18
1	0,55	0,34
2	0,92	0,55
3	1,29	0,74
4	1,47	0,92
5	1,84	1,1
6	2,21	1,29
7	2,39	1,47

- 8.3.1 Identifiseer die:
- (a) Afhanklike veranderlike (1)
- (b) Onafhanklike veranderlike (1)

- 8.3.2 Vanuit die resultate, lei die verwantskap tussen die ioonkonsentrasie in 'n oplossing en sy geleidingsvermoë af. (1)
- 8.3.3 Gebruik gebalanseerde chemiese vergelykings om te verduidelik hoekom $\text{CaCl}_2(\text{aq})$ 'n sterker elektroliet as $\text{NaCl}(\text{aq})$ is. (4)
- 8.4 Dui die tipe reaksie aan wat deur elk van die volgende vergelykings voorgestel word. Skryf slegs PRESIPITASIE, REDOKS of GASVORMING neer.
- 8.4.1 $\text{Zn}(\text{s}) + \text{CuSO}_4(\text{aq}) \rightarrow \text{Cu}(\text{s}) + \text{ZnSO}_4(\text{aq})$ (1)
- 8.4.2 $\text{Zn}(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{ZnCl}_2(\text{aq}) + \text{H}_2(\text{g})$ (1)
- 8.4.3 $\text{Na}_2\text{CO}_3(\text{aq}) + \text{BaCl}_2(\text{aq}) \rightarrow 2\text{NaCl}(\text{aq}) + \text{BaCO}_3(\text{s})$ (1)
- 8.5 Skryf 'n gebalanseerde chemiese vergelyking vir die volgende woordvergelyking neer:
- Salpetersuur + koper $\rightarrow$ koper(II)nitraat + water + stikstofdoksied (3)
- [19]**

VRAAG 9 (Begin op 'n nuwe bladsy.)

- 9.1 Waterstof, $\text{H}_2(\text{g})$, en stikstof, $\text{N}_2(\text{g})$, reageer om ammoniak, $\text{NH}_3(\text{g})$, te vorm. Die reaksie wat plaasvind, word deur die volgende vergelyking voorgestel:
- $$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$$
- 9.1.1 Definieer die term 1 mol. (2)
- 9.1.2 Hoeveel mol ammoniak sal uit 1 mol waterstofgas geproduseer word? (1)
- 9.1.3 Aanvanklik word 10 cm^3 stikstof en 24 cm^3 waterstof in 'n houer gemeng. Die temperatuur en druk bly konstant.
- Bereken die volume gas wat in die houer sal oorbly nadat die reaksie voltooi is. (4)
- In 'n ander eksperiment reageer 80 g waterstofgas met stikstofgas om ammoniak te vorm.
- Bereken die:
- 9.1.4 Getal mol waterstofgas wat gereageer het (2)
- 9.1.5 Volume van die stikstofgas wat by STD gebruik is (2)
- 9.2 Wanneer 207 g lood, Pb, met suurstof verbind, word 239 g van 'n sekere oksied van lood gevorm. Gebruik 'n berekening om die formule van hierdie oksied van lood te bepaal. (5)
- [16]**

- 8.1. A worked memo is available for this question at <http://tinyurl.com/ScienceClinicYoutube>
What 2 conditions must be satisfied before a substance will conduct electricity?
- 8.2. A worked memo is available for this question at <http://tinyurl.com/ScienceClinicYoutube>
For each of the following substances predict whether it will conduct electricity, giving reasons.
NB – prediction must be done based on what you KNOW. It is not a random guess.

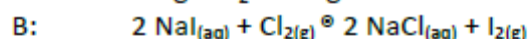
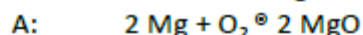
Substance	Prediction	Reason
Water - distilled		
Water – tap		
Copper wire		
NaCl in aqueous solution		
Xylene – made of molecules with covalent bonds		
Sulphur		

- 8.3. A worked memo is available for this question at <http://tinyurl.com/ScienceClinicYoutube>
The conductivity of each substance may be tested using a circuit made up of 2 cells connected to an ammeter. The liquids can be connected into the circuit using carbon electrodes.
Draw a circuit diagram of the circuit.
- 8.4. A worked memo is available for this question at <http://tinyurl.com/ScienceClinicYoutube>
Write a description of why charges move when aqueous solutions of ionic substances conduct electricity. Please include a diagram with your explanation.
- 8.5. A worked memo is available for this question at <http://tinyurl.com/ScienceClinicYoutube>
The electrical conductivity of four different magnesium chloride solutions was tested. The concentrations of the solutions were 10mol.dm^{-3} , 20mol.dm^{-3} , 40mol.dm^{-3} and 80mol.dm^{-3} . The current through each solution was measured and found to be 0,013A, 0,025A, 0,040A and 0,051A respectively. The distance between the electrodes and the voltage applied was kept constant.
- 8.5.1. Name the independent and dependent variables.
- 8.5.2. List two variables which were controlled. (kept constant)
- 8.5.3. Draw a table of the results.
- 8.5.4. Plot a graph showing the relationship between the concentration vs. current.
- 8.5.5. Write a justified conclusion of the experiment.
- 8.5.6. Write an equation showing the dissolution of the magnesium chloride.

Science Clinic 2

8.6. A worked memo is available for this question at <http://tinyurl.com/ScienceClinicYoutube>

Consider the following reactions A and B:



8.6.1. Rewrite reaction A showing the subscripts for the phases.

8.6.2. Which of the reactions is an ion exchange reaction? Explain.

8.6.3. Which of the reactions is a redox reaction? Explain.

8.6.4. How would you test to see which anions are present in the products of Reaction B?

8.7. A worked memo is available for this question at <http://tinyurl.com/ScienceClinicYoutube>

A precipitate is a solid that is formed in solution when a chemical reaction forms an insoluble substance. Listed below are 3 sets of mixtures that will result in the formation of a precipitate. For each of the mixtures, state the formula as well as colour of the precipitate

	Mixtures	Precipitate Formula	Colour of precipitate
8.7.1	Lead nitrate and potassium chloride		
8.7.2	Sodium carbonate and calcium chloride		
8.7.3	Sodium bromide and silver nitrate		

8.8. A worked memo is available for this question at <http://tinyurl.com/ScienceClinicYoutube>

A chemistry student makes up an ammonium carbonate solution; using a ammonium carbonate crystals and tap water she notices that the solution is not quite clear. She concludes that ammonium carbonate is not very soluble. Is her conclusion correct or not? Explain your answer fully.

8.9. A worked memo is available for this question at <http://tinyurl.com/ScienceClinicYoutube>

The student then needs to make a sodium iodide solution. She sees some 'water' standing in a beaker on the lab bench. She adds a spatula of sodium iodide powder to this 'water' and to her amazement the solution turns into a bright yellow. With the aid of an ionic equation explain what mostly likely happened.

Science Clinic 3

8.10. A worked memo is available for this question at <http://tinyurl.com/ScienceClinicYoutube>

Which of the following mixtures will have a better conductivity as an electrolyte if all solutions have a concentration of $0,1 \text{ mol} \cdot \text{dm}^{-3}$? Give a reason for your answer.

Mixture A: sodium chloride and sodium hydroxide.

Mixture B: Aluminium nitrate and sodium hydroxide.

QUANTITATIVE ASPECTS

EXAM LEVEL QUESTIONS

9.1. A worked memo is available for this question at <http://tinyurl.com/ScienceClinicYoutube>

9.1.1. Calculate the percent by mass of NITROGEN present in ammonium phosphate $[(\text{NH}_4)_3\text{PO}_4]$.

9.1.2. What is the molar mass of hexane (C_6H_{14})?

9.1.3. How many molecules of hexane are there in 4,3g of this compound?

9.2. A worked memo is available for this question at <http://tinyurl.com/ScienceClinicYoutube>

Determine the empirical formula of a compound that is 29,0% sodium, 40,5% sulphur, and 30,4 % oxygen by weight.

9.3. A worked memo is available for this question at <http://tinyurl.com/ScienceClinicYoutube>

A sample containing 5 g of Li_2CO_3 is dissolved into water and the solution is made up to a total volume of 100 cm^3 .

Calculate:

9.3.1. The number of moles of Li_2CO_3 which is in 5g.

9.3.2. The concentration of solution that is formed.

9.4. $\text{Na} + \text{Cl}_2 \rightarrow \text{NaCl}$

9.4.1. Balance the above equation.

9.4.2. 2 mol of Na react. What mass of NaCl will be formed?

9.4.3. 2 mol of Na react. What mass of chlorine must be present to react with the Na?

9.4.4. What volume of chlorine reacts with 2,5 mol of sodium at STP?

9.5. Magnesium reacts with hydrochloric acid according to the following word equation:

magnesium + hydrochloric acid $\rightarrow$ magnesium chloride + hydrogen gas

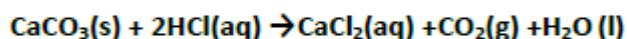
Calculate the volume of hydrogen gas (at STP i.e. 0°C and $101,3 \text{ kPa}$) produced from the reaction of 14,6 g of hydrochloric acid.

Science Clinic 4

- 9.6. A worked memo is available for this question at <http://tinyurl.com/ScienceClinicYoutube>. Thermite is a composition of a metal powder and a metal oxide that causes an exothermic reaction known as the thermite reaction. When aluminium powder is mixed with manganese (IV) oxide powder and the mixture is ignited, extremely high temperatures of up to 2500°C are caused. The unbalanced equation for this reaction is:

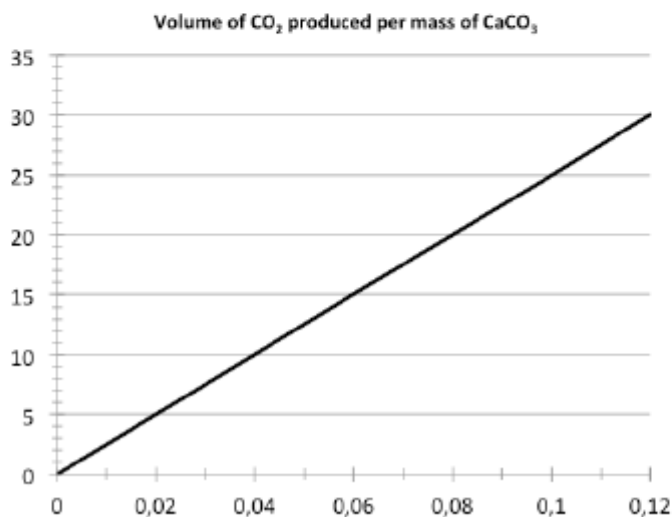


- 9.6.1. What is the meaning of the Roman numeral (IV) in the name of manganese (IV) oxide?
- 9.6.2. Balance this equation.
- 9.6.3. Give the Law of Conservation of Mass in words.
- 9.6.4. Prove that the Law of Conservation of Mass is valid for the balanced equation.
- 9.7. Calcium carbonate, CaCO_3 , reacts with dilute hydrochloric acid, HCl , according to the following balanced equation: .



- 9.7.1. The above reaction is an example of an acid-base reaction. Define the term acid-base reaction.

The graph below shows the relationship between the volume of carbon dioxide gas, $\text{CO}_2\text{(g)}$ formed and the mass of PURE calcium carbonate.



- 9.7.2. From the graph, determine the volume of $\text{CO}_2\text{(g)}$ produced when 0,064 g of PURE CaCO_3 (s) reacts.

Science Clinic 5

9.7.3. Rennies, a tablet used to neutralize stomach acid, has a mass of 0,5g and contains mainly calcium carbonate which reacts with dilute hydrochloric acid in the stomach to produce carbon dioxide gas. The concentration of hydrochloric acid in the stomach is $0,15\text{mol}\cdot\text{dm}^{-3}$.

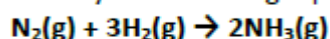
9.7.3.1. Define the term concentration of a solution.

It is found that 30 cm^3 of $\text{CO}_2(\text{g})$ is formed when one antacid tablet completely reacts.

9.7.3.2. Use the information in the graph and calculate the percentage $\text{CaCO}_3(\text{s})$ in one antacid tablet.

9.7.3.3. Calculate the volume of hydrochloric acid that will be neutralized by ONE antacid tablet.

9.8. Hydrogen, $\text{H}_2(\text{g})$, and nitrogen, $\text{N}_2(\text{g})$, react to form ammonia, $\text{NH}_3(\text{g})$. The reaction that takes place is represented by the following equation:



9.8.1. Define the term *1 mol*

9.8.2. How many moles of ammonia will be produced from 3mol of hydrogen gas?

9.8.3. Initially 15cm^3 of nitrogen and 30cm^3 of hydrogen are mixed in a container.

The temperature and pressure remain constant.

Calculate the volume of gas that will remain in the container after the reaction is completed.

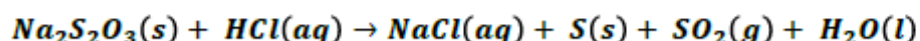
In another experiment, 80 g of hydrogen gas reacts with nitrogen gas to form ammonia.

Calculate the:

9.8.4. Number of moles of nitrogen gas reacted.

9.8.5. Volume of the hydrogen gas used at STP.

9.9. Sodium thiosulphate, $\text{Na}_2\text{S}_2\text{O}_3(\text{s})$, reacts with 400cm^3 of hydrochloric acid solution, $\text{HCl}(\text{aq})$, of concentration of $0,15\text{mol}\cdot\text{dm}^{-3}$ according to the following equation:



9.9.1. Rewrite the equation as a balanced equation.

9.9.2. Calculate the number of moles of $\text{HCl}(\text{aq})$ added to the sodium thiosulphate.

9.9.3. Calculate:

9.9.3.1. The volume of $\text{SO}_2(\text{g})$ that will form from the reaction.

9.9.3.2. The mass of the sulphur precipitate.

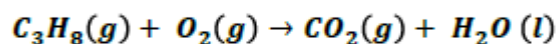
9.9.3.3. The concentration of sodium chloride in the 400cm^3 solution.

Clinic 6

The reaction can be used to extract sulphur from sodium thiosulfate.

9.9.4. Determine the mass of sodium thiosulfate required to form 50g of sulphur in excess hydrochloric acid

9.10. Propane is a combustible gas that can be used as a fuel source. Propane will burn in oxygen according to the equation:



9.10.1. Rewrite the equation above as a balanced equation.

9,48g of propane was burned in excess oxygen.

9.10.2. Determine:

9.10.2.1. The number of propane particles that reacted with oxygen.

9.10.2.2. The volume of oxygen that reacted with the propane.

9.10.2.3. The mass of all the products.

Reaksies in waterige oplossing, Kwantitatiewe Aspekte Memo

November 2018/1

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 $\text{Na}_2\text{CO}_3(\text{s}) \rightarrow 2\text{Na}^+(\text{aq}) + \text{CO}_3^{2-}(\text{aq})$
Products: ✓ Balancing: ✓/Produkke:/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 $c(\text{HCl}) = \frac{n(\text{HCl})}{V(\text{HCl})}$ ✓
 $1 = \frac{n(\text{HCl})}{0,005}$ ✓
 $n = 0,005 \text{ mol}$ ✓ (3)

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

$$n(\text{NaCl}) : n(\text{HCl}) = 1 : 1$$

$$n(\text{NaCl}) = \frac{1}{1} \times 0,005 \checkmark$$

$$n(\text{NaCl}) = 0,005 \text{ mol}$$

$$n(\text{NaCl}) = \frac{m}{M} \checkmark$$

$$0,005 \checkmark = \frac{m}{58,5 \checkmark} \checkmark$$

$$m = 0,29 \text{ g} \checkmark$$

Marking criteria/Nasienriglyne:

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

(5)
[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 (2)
forfeited/Indien leerder verwys na beweging van elektrone, penaliseer met 1 punt.

- 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. <i>Afhanklike en onafhanklike veranderlikes korrek genoem.</i>	✓
Ask a question about the relationship between the independent and dependent variables. <i>Vra 'n vraag oor die verwantskap tussen die onafhanklike en afhanklike veranderlikes.</i>	✓

- 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 ✓/In 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 ✓/In Oplossing van suiker
 It contains no free ions. ✓/Dit bevat geen vrye ione nie. (2)

Reaksies in waterige oplossing, Kwantitatiewe Aspekte Memo
November 2018/3

8.4 $n(\text{C}) : \text{C}(\text{H}) : n(\text{O})$

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

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

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

$$3,33 : 6,67 : 3,33$$

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

$$1 : 2 : 1 \checkmark$$

Empirical formula/*Empiriese formule*: CH_2O

$$M(\text{CH}_2\text{O}) = 12 + 2 + 16 = 30 \text{ g} \cdot \text{mol}^{-1} \checkmark$$

$$\text{Factor/Faktor} = \frac{180}{30} = 6 \checkmark$$

$\therefore$ Molecular formula/*Molekulêre formule* is: $\text{C}_6\text{H}_{12}\text{O}_6 \checkmark$

(7)
[11]

QUESTION 9/VRAAG 9

9.1 Precipitation reaction ✓/Presipitasie reaksie (1)

9.2.1 Sulphate ✓/Sulfaat (1)

9.2.2 $\text{BaCO}_3 + 2\text{HNO}_3 \checkmark \rightarrow \text{Ba}(\text{NO}_3)_2 + \text{CO}_2 + \text{H}_2\text{O} \checkmark$

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

9.3.1
$$n(\text{Na}_2\text{CO}_3) = \frac{m}{M} \checkmark$$
$$= \frac{5}{106} \checkmark$$
$$= 0,047 \text{ mol}$$

$$n(\text{BaCO}_3) : n(\text{Na}_2\text{CO}_3)$$

$$1 : 1 \checkmark$$

$$m(\text{BaCO}_3) = n \times M$$

$$= 0,047 \times 197 \checkmark$$

$$= 9,26 \text{ g} \checkmark \quad (\text{Range/Gebied: } 9,25 - 9,87) \quad (5)$$

Marking criteria/Nasienriglyne:

- Formula/Formule $n = \frac{m}{M} \checkmark$
- Substitution/Inervanging ✓
- Using ratio/Gebruik verhouding ✓
- Multiply by/Vermenigvuldiging met $197 \text{ g} \cdot \text{mol}^{-1} \checkmark$ 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**

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

$$= \frac{8,3}{9,26} \times 100 \checkmark$$

$$= 89,63\% \checkmark \quad (\text{Range/Gebied: } 84,26 - 89,64) \quad (2)$$

[12]

1.7 D ✓✓ (2)

QUESTION 6/VRAAG 6

6.1.1 Gas forming ✓ / Gasvormende reaksie ✓ (1)

6.2.1 $M(\text{Na}_2\text{CO}_3) = 2(23) + 12 + 3(16)$
 $= 106 \text{ g} \cdot \text{mol}^{-1}$ ✓✓ (2)

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

$$n(\text{Na}_2\text{CO}_3) = \frac{m}{M}$$

$$= \frac{10,6}{106} \text{ ✓}$$

$$= 0,1 \text{ mol ✓} \quad (2)$$

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

OPTION 1/OPSIE 1:

$$n(\text{Na}_2\text{CO}_3) : n(\text{CO}_2)$$

$$1 : 1 \text{ ✓}$$

Thus: $n(\text{CO}_2) = 0,1 \text{ mol}$

$$n(\text{CO}_2) = \frac{m}{M} \text{ ✓}$$

$$0,1 = \frac{m}{44} \text{ ✓}$$

$$m = 4,4 \text{ g ✓}$$

OPTION 2/ OPSIE 2:

$$106 \text{ g of Na}_2\text{CO}_3 : 44 \text{ g of CO}_2 \text{ ✓✓}$$

$$10,6 \text{ g} : 4,4 \text{ g CO}_2 \text{ ✓✓}$$

(4)

6.2.4

$$n(\text{CO}_2) = \frac{V_{\text{CO}_2}}{V_m}$$

$$= \frac{4,87}{22,4} \text{ ✓}$$

$$= 0,217 \text{ mol}$$

NOTE/ NOTA:

One mark for any one formula
 Een punt vir enige een formule

$$n(\text{CO}_2) : n(\text{NaCl})$$

$$1 : 2 \text{ ✓}$$

$$n(\text{NaCl}) = 0,434 \text{ mol}$$

$$n(\text{NaCl}) = \frac{m}{M} \text{ ✓}$$

$$0,434 = \frac{m}{58,5} \text{ ✓}$$

$$m = 25,16 \text{ g ✓}$$

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)

6.3

OPTION1/OPSIE 1:

$$\begin{aligned}\text{Mass of H}_2\text{O} &= 14,2 - 5,3 \\ &= 8,9 \text{ g} \quad \checkmark\end{aligned}$$

$$\begin{aligned}n(\text{Na}_2\text{CO}_3) &= \frac{m}{M} & n(\text{H}_2\text{O}) &= \frac{m}{M} \\ &= \frac{5,3}{106} \quad \checkmark & &= \frac{8,9}{18} \quad \checkmark \\ &= 0,05 \text{ mol} & &= 0,5 \text{ mol}\end{aligned}$$

$$\begin{aligned}\text{Na}_2\text{CO}_3 : \text{H}_2\text{O} \\ \frac{0,05}{0,05} : \frac{0,5}{0,05} \quad \checkmark \text{ Divide by smallest number} \\ 1 : 10\end{aligned}$$

$$\text{Thus } x = 10 \quad \checkmark$$

OPTION 2/OPSIE 2:

$$\begin{aligned}\text{Mass of H}_2\text{O} &= 14,2 - 5,3 \\ &= 8,9\text{g} \quad \checkmark\end{aligned}$$

$$M(\text{Na}_2\text{CO}_3) = 160 \text{ g}\cdot\text{mol}^{-1} \quad M(\text{H}_2\text{O}) = 18 \text{ g}\cdot\text{mol}^{-1}$$

$$\begin{aligned}n(\text{Na}_2\text{CO}_3) : n(\text{H}_2\text{O}) \\ \frac{m(\text{Na}_2\text{CO}_3)}{M(\text{Na}_2\text{CO}_3)} : \frac{m(\text{H}_2\text{O})}{M(\text{H}_2\text{O})} \quad \checkmark \\ \frac{5,3}{160} : \frac{8,9}{18} \quad \checkmark \\ 0,05 : 0,5 \\ \frac{0,05}{0,05} : \frac{0,5}{0,05} \quad \checkmark \text{ Divide by smallest number} \\ 1 : 10\end{aligned}$$

$$\text{Thus } x = 10 \quad \checkmark$$

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 $\text{AgNO}_3(\text{s}) \rightarrow \text{Ag}^+(\text{aq}) + \text{NO}_3^-(\text{aq})$ ✓
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 $\text{AgNO}_3 = (5,3)(2)$
 $= 10,6 \text{ g}$ ✓

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

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)

Reaksies in waterige oplossing, Kwantitatiewe Aspekte Memo

November 2017/4

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 $\text{CO}_3^{2-}(\text{aq}) + \text{BaCl}_2(\text{aq}) \checkmark \rightarrow \text{BaCO}_3(\text{s})\checkmark + 2\text{Cl}^-(\text{aq}) \checkmark$ Bal ✓

NOTE/NOTA: Phases need not be shown/ *Fases kan uitgelaat word*

(4)

8.3 $\text{BaCO}_3(\text{s}) + \text{HNO}_3(\text{aq}) \checkmark \rightarrow \text{Ba}(\text{NO}_3)_2(\text{aq}) + \text{CO}_2(\text{g})\checkmark + \text{H}_2\text{O}(\text{l})\checkmark$ 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 $\text{KCl} \rightarrow \text{K}^+ + \text{Cl}^-$ ✓ ✓ (3)

7.3 $\text{KCl} : \text{K}^+$
1 : 1
Thus 2 mol of KCl dissolves. ✓✓
Dus 2 mol KCl 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
$M(O) = 16 \text{ g} \cdot \text{mol}^{-1}$	$M(C) = 12 \text{ g} \cdot \text{mol}^{-1}$	$M(H) = 1 \text{ g} \cdot \text{mol}^{-1}$
$n = m/M$	$n = m/M$	$n = m/M$
$n = 53,3/16$	$n = 40/12$	$n = 6,6/1$
$n = 3,33125 \text{ mol} \checkmark$	$n = 3,3 \text{ mol} \checkmark$	$n = 6,6 \text{ mol} \checkmark$

Thus/Dus:

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

Empirical formula/Empiriese formule = $\text{C H}_2 \text{O} \checkmark$

ACCEPT TABLE METHOD
AANVAAR TABEL METODE

(5)

8.1.3 $M(\text{CH}_2\text{O})$
 $= 12 + 2(1) + 16$
 $= 30 \text{ g} \cdot \text{mol}^{-1} \checkmark$

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

Thus the molecular formula

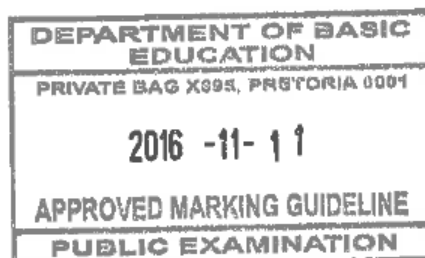
Dus is die molekulêre formule $= (\text{CH}_2\text{O}) \times 2$
 $= \text{C}_2\text{H}_4\text{O}_2 \checkmark$

(3)

8.2 $M(\text{Na}_2\text{CO}_3) = 106 \text{ g} \cdot \text{mol}^{-1} \checkmark$

$M(x \text{H}_2\text{O}) = 268 - 106$
 $= 162 \text{ g} \cdot \text{mol}^{-1} \checkmark$

$n(\text{H}_2\text{O}) = \frac{162}{18} \checkmark$
 $= 9 \text{ mol} \checkmark$



(4)
[14]

QUESTION 9/VRAAG 9

9.1 Temperature/*Temperatuur*: 273 K or/of 0 °C ✓
 Pressure/*Druk*: $1,013 \times 10^5$ 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. <u>OPTION 1/OPSIE 1:</u> $n(\text{Na}) = \frac{m}{M} \quad \checkmark$ $= \frac{10}{23} \quad \checkmark$ $= 0,43 \text{ mol Na}$ Na : H₂ 2 : 1 ✓ Thus 0,22 mol H₂ produced ✓ <i>Dus 0,22 mol H₂ word geproduseer.</i> $n(\text{H}_2) = \frac{m}{M}$ $0,22 = \frac{m}{2}$ $m = 0,43 \text{ g} \quad \checkmark \text{ H}_2$ produced/<i>gevorm</i> <u>OPTION 2/OPSIE 2:</u> 2 mol Na produces 1 mol H₂ ✓ (2)(23g) ✓ produces (1)(2g) ✓ 10g produces x ✓ x = 0,43g ✓	MARK OPTION 3 IF 2dm³ WATER IS USED MERK OPSIE 3 INDIEN 2dm³ WATER GEBRUIK IS. <u>OPTION 3/OPSIE 3:</u> 2 mol H₂O : 1 mol H₂ ✓ (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/OPSIE 1:

$$n(\text{H}_2) = \frac{V}{V_m} \checkmark$$

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

$$V = 4,93 \text{ dm}^3 \checkmark$$

Accept 4,82 dm³

OPTION 2/OPSIE 2:

$$1 \text{ mol} : 22,4 \text{ dm}^3 \checkmark$$

$$2\text{g} : 22,4 \text{ dm}^3 \checkmark$$

$$0,43\text{g} : x$$

$$x = 4,82 \text{ dm}^3 \checkmark$$

MARK OPTION 3 IF 2dm³ WATER IS USED
MERK OPSIE 3 INDIEN 2dm³ WATER GEBRUIK IS.

OPTION 3/OPSIE 3:

$$1 \text{ mol} : 22,4 \text{ dm}^3 \checkmark$$

$$2\text{g} : 22,4 \text{ dm}^3 \checkmark$$

$$111,11\text{g} : x$$

$$x = 1244,43 \text{ dm}^3$$

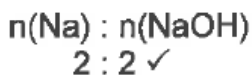
(3)

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:



Thus mol NaOH = 0,43 mol
Dus mol NaOH = 0,43 mol

$$n(\text{NaOH}) = \frac{m}{M} \checkmark$$

$$0,43 = \frac{m}{(23 + 16 + 1)} \checkmark$$

$m = 17,2 \text{ g} \checkmark$ of NaOH produced/gevorm

OPTION 2/OPSIE 2:

1 mol Na produces/produseer 1 mol NaOH $\checkmark$

23g produces/produseer 40g $\checkmark$

10g produces/produseer $x \checkmark$

$x = 17,39\text{g} \checkmark$

MARK OPTION 3 IF 2dm³ WATER IS USED
MERK OPSIE 3 INDIEN 2dm³ WATER GEBRUIK IS.

OPTION 3/OPSIE 3:

1 mol H₂O : 1 mol NaOH $\checkmark$

18g : 40g $\checkmark$

2000g : $x \checkmark$

$x = 4444,44\text{g} \checkmark$

(4)

9.2.4

POSITIVE MARKING FROM 9.2.3
POSITIEWE NASIEN VAN 9.2.3

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

$$c = \frac{0,43}{2} \checkmark$$

$$c = 0,22 \text{ mol.dm}^{-3} \checkmark$$

no

(3)
[14]

QUESTION 10/VRAAG 10

- | | | |
|------|---|-----|
| 10.1 | Precipitate ✓ / <i>Presipitaat/Neerslag</i> | (1) |
| 10.2 | 10.2.1 Step I: BaCl_2 ✓
Step II: no reaction ✓

<i>Stap I: BaCl_2</i>
<i>Stap II: geen reaksie ✓</i> | (2) |
| | 10.2.2 Step I: AgNO_3 ✓
Step II: HNO_3 ✓

<i>Stap I: AgNO_3</i>
<i>Stap II: HNO_3</i> | (2) |
| | 10.2.3 White ✓ / <i>Wit</i> | (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 cm³ ✓ (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 $\% \text{CaCO}_3 = \frac{0,1}{0,25} \times 100$ ✓
 = 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.

$$\begin{aligned} n(\text{CaCO}_3) &= \frac{m}{M} \\ &= \frac{0,1}{100} \checkmark \\ &= 1 \times 10^{-3} \text{ mol} \end{aligned}$$

$$n(\text{HCl}) = 2 \times n(\text{CaCO}_3) = 2 \times 10^{-3} \text{ mol} \checkmark$$

Volume acid/volume suur:

$$\begin{aligned} c &= \frac{n}{V} \checkmark \\ 0,1 &= \frac{2 \times 10^{-3}}{V} \checkmark \\ V &= 0,02 \text{ dm}^3 \checkmark \end{aligned}$$

(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 $(\text{NH}_4)_2\text{CO}_3(\text{s}) \rightarrow 2\text{NH}_4^+(\text{aq}) + \text{CO}_3^{2-}(\text{aq})$ ✓ bal. ✓ (3)

Notes/Aantekeninge

- Reactants ✓ Products ✓ Balancing ✓
Reaktanse ✓ Produkte ✓ Balansering ✓
- Ignore/Ignoreer $\rightleftharpoons$ 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 ionkonsentrasie verhoog die geleidingsvermoë. (1)

8.3.3 $\text{NaCl} \rightarrow \text{Na}^+ + \text{Cl}^-$ ✓
Forms two ions per mole of NaCl./Vorm twee ione per mol NaCl. ✓
 $\text{CaCl}_2 \rightarrow \text{Ca}^{2+} + 2\text{Cl}^-$ ✓
Forms three ions per mole of CaCl_2 ./Vorm drie ione per mol CaCl_2 . ✓

OR/OF

Concentration of ions in $\text{CaCl}_2(\text{aq})$ is higher than in $\text{NaCl}(\text{aq})$. ✓✓
Konsentrasie van ione in $\text{CaCl}_2(\text{aq})$ is hoër as in $\text{NaCl}(\text{aq})$. (4)

8.4

8.4.1 Redox/Redoks ✓ (1)

8.4.2 Gas forming/Gasvorming ✓ (1)

8.4.3 Precipitation/Presipitasie ✓ (1)

8.5 $\text{Cu} + 4\text{HNO}_3 \rightarrow \text{Cu}(\text{NO}_3)_2 + 2\text{H}_2\text{O} + 2\text{NO}_2$ ✓ Bal. ✓

Notes/Aantekeninge

- Reactants ✓ Products ✓ Balancing ✓
Reaktanse ✓ Produkte ✓ Balansering ✓
- Ignore/Ignoreer $\rightleftharpoons$
- 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 $0,67 \text{ mol} / \frac{2}{3} \text{ mol}$ ✓ (1)

9.1.3 $V(\text{N}_2) : V(\text{H}_2) : V(\text{NH}_3) = 1 : 3 : 2$
 $V(\text{N}_2 \text{ reacted/reageer}) = \frac{1}{3} V(\text{H}_2)$
 $= \frac{1}{3} (24) \checkmark$
 $= 8 \text{ dm}^3$

Volume N_2 remains/oorbly = $10 - 8 \checkmark = 2 \text{ dm}^3$

Volume of gas that remains/Volume gas wat oorbly = $2 + \frac{16}{3} \checkmark$
 $= 18 \text{ dm}^3 \text{ gas} \checkmark$ (4)

$$\begin{aligned}
 9.1.4 \quad n &= \frac{m}{M} \\
 &= \frac{80}{2} \checkmark \\
 &= 40 \text{ mol} \checkmark
 \end{aligned}
 \tag{2}$$

$$\begin{aligned}
 9.1.5 \quad V(\text{N}_2) &= \frac{1}{3} (40) \times 22,4 \checkmark \\
 &= 298,67 \text{ dm}^3 \checkmark
 \end{aligned}
 \tag{2}$$

$$9.2 \quad m(\text{O}_2) = 239 - 207 = 32 \text{ g} \checkmark$$

$$\begin{aligned}
 n(\text{Pb}) &= \frac{m}{M} \\
 &= \frac{207}{207} \checkmark \\
 &= 1 \text{ mol}
 \end{aligned}$$

$$\begin{aligned}
 n(\text{O}) &= \frac{m}{M} \\
 &= \frac{32}{16} \checkmark \\
 &= 2 \text{ mol}
 \end{aligned}$$

$$\begin{aligned}
 n(\text{Pb}) : n(\text{O}) \\
 1 : 2 \checkmark \\
 \therefore \text{PbO}_2 \checkmark
 \end{aligned}$$

(5)
[16]

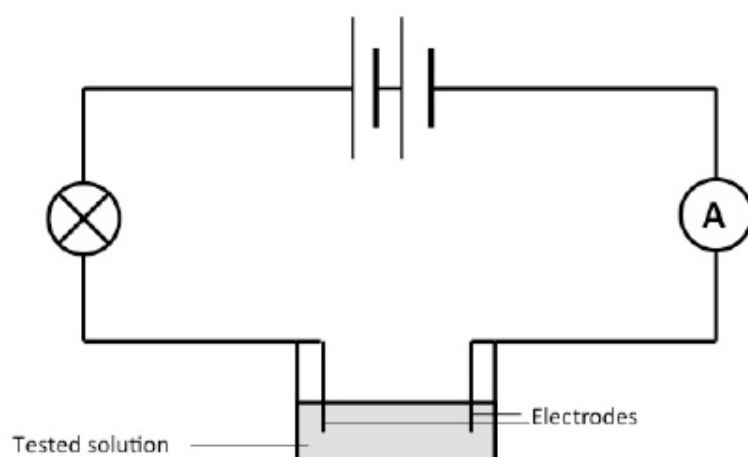
Science Clinic 1

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

8.2.

Substance	Predicti on	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.

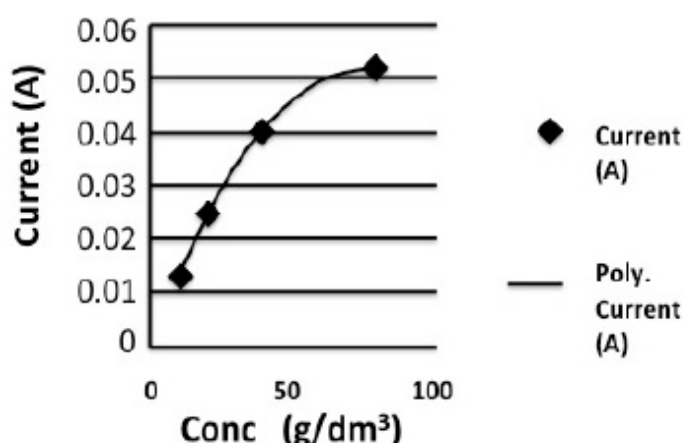
Science Clinic 2

8.5.3.

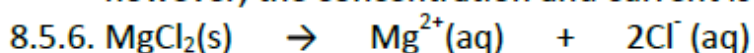
Data	Conc / [g dm ⁻³]	Current /[A]
1	10	0,013
2	20	0,025
3	40	0,040
4	80	0,051

8.5.4.

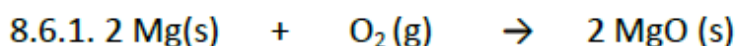
Current as a function of concentration



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



8.6.



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 AgNO_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

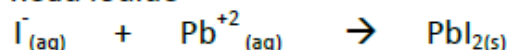
8.7.3. AgBr , cream

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

Science Clinic 3

concentration precipitate leaving the solution murky.

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



- 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 $[(\text{NH}_4)_3\text{PO}_4]$.

$$\% \text{ by mass} = 3 \text{ nitrogen atoms} / [(\text{NH}_4)_3\text{PO}_4] \times 100 = 3 \times 14 / (149) \times 100 = 28,19 \%$$

- 9.1.2. Molar mass of hexane $(\text{C}_6\text{H}_{14}) = 72 + 14 = 86 \text{ g mol}^{-1}$

- 9.1.3. Moles of hexane are there in 4,3g: $n = m / M = 0,05 \text{ mol}$

$$\text{Molecules of hexane are there in 4,3g} = 0,05 \times 6,02 \times 10^{23} = 3,01 \times 10^{22}$$

- 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 $\text{Na}_2\text{S}_2\text{O}_3$

9.3.

- 9.3.1. number of moles of $\text{Li}_2\text{CO}_3 = m / M = 5 / (14+12+48) = 0,068 \text{ mol}$

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

9.4.

- 9.4.1. $2 \text{ Na} + \text{Cl}_2 \rightarrow 2 \text{ NaCl}$

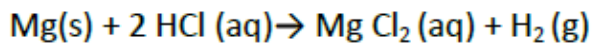
- 9.4.2. 2 mol Na form 2 mol NaCl. Mass = $n \times M = 2 \times 58,5 = 117\text{g}$

- 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 $\text{Cl}_2 = 1,25 \times 22,4 = 28\text{dm}^3$

Science Clinic 4

9.5. magnesium + hydrochloric acid $\rightarrow$ magnesium chloride + hydrogen gas



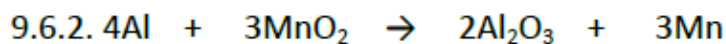
$$n(\text{hydrochloric acid}) = 14,6 \text{ g} / 36,5 = 0,4 \text{ mol}$$

$$n(\text{hydrogen gas}) = 0,2 \text{ mol}$$

$$\text{volume of hydrogen gas} = 0,2 \times 22,4 = 4,48 \text{ dm}^3.$$

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+.



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

$$9.6.4. M_r(\text{reactants}) = 4(27) + 3(55 + (16 \times 2)) \\ = 369$$

$$M_r(\text{products}) = 2((27 \times 2) + (16 \times 3)) + (3 \times 55) \\ = 369$$

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

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.

$$9.7.2. 17 \text{ cm}^3$$

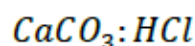
9.7.3.

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

$$9.7.3.2. 30 \text{ cm}^3 = 0,12 \text{ g}$$

$$\% \text{CaCO}_3 \text{ in antacid tablet} = \frac{0,12}{0,5} \times 100 = 24\%$$

$$9.7.3.3. n(\text{CaCO}_3) = \frac{m}{M} \\ = \frac{0,12}{100} \\ = 1,2 \times 10^{-3} \text{ mol}$$



$$1 : 2$$

$$1,2 \times 10^{-3} : 2,4 \times 10^{-3}$$

$$c = \frac{n}{V}$$
$$0,15 = \frac{2,4 \times 10^{-3}}{V}$$
$$V = \frac{2,4 \times 10^{-3}}{0,15}$$
$$V = 0,016 \text{ dm}^3$$
$$\therefore = 16 \text{ mL}$$

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

$\therefore n(NH_3) = 2 \text{ mol}$

9.8.3. *Hydrogen is the limiting reactant*

number of moles N_2 used:

$H_2 : N_2$

3: 1

30: 10

$\therefore \text{amount of } N_2 \text{ remaining} = 5 \text{ cm}^3$

number of moles of NH_3 :

$H_2 : NH_3$

3: 2

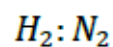
30: 20

$\therefore \text{amount of } NH_3 \text{ produced} = 20 \text{ cm}^3$

$\text{Volume remaining} = 5 + 20 = 25 \text{ cm}^3$

Science Clinic 6

$$\begin{aligned} 9.8.4. \quad n(H_2) &= \frac{m}{M} \\ &= \frac{80}{2} \\ &= 40 \text{ mol} \end{aligned}$$



$$3 : 1$$

$$2,86 : 0,96$$

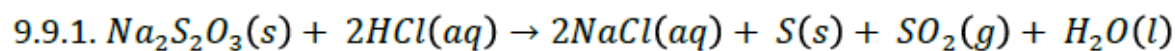
$$\therefore n(N_2) = 0,95 \text{ mol}$$

$$\begin{aligned} 9.8.5. \quad n &= \frac{V}{V_M} \\ 0,95 &= \frac{V}{22,4} \end{aligned}$$

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

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

9.9.



$$9.9.2. \quad n(HCl) = cV$$

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

$$= 0,06 \text{ mol}$$

9.9.3.



$$2 : 1$$

$$0,06 : 0,03$$

$$\begin{aligned} n &= \frac{V}{V_M} \\ 0,03 &= \frac{V}{22,4} \\ V &= (0,06)(22,4) \\ V &= 0,672 \text{ dm}^3 \end{aligned}$$

Science Clinic 7

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

0,06:0,06

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

$$c = \frac{0,06}{0,4}$$

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

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

$$= \frac{50}{32}$$

$$= 1,56mol$$

$S:Na_2S_2O_3$

1:1

1,56:1,56

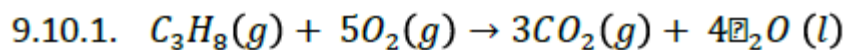
$$n = \frac{m}{M}$$

$$1,56 = \frac{m}{158}$$

$$m = (1,56)(158)$$

$$m = 246,48g$$

9.10.



Science Clinic 8

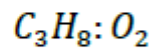
9.10.2.

9.10.2.1.

$$\begin{aligned}n(C_3H_8) &= \frac{m}{M} \\&= \frac{9,48}{44} \\&= 0,22mol\end{aligned}$$

$$\begin{aligned}\text{no. of particles} &= nN_A \\&= (0,22)(6,02 \times 10^{23}) \\&= 1,32 \times 10^{23} \text{ particles}\end{aligned}$$

9.10.2.2.



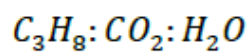
1:5

0,22: 1,1

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

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9.10.2.3.



$$1:3:4$$

$$0,22:0,66:0,88$$



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

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

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

$$29,04g$$



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

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

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

$$m = 15,84g$$

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