semester test (1) 2008

CMY 117

Vraag 1 **Metingseenhede en Omskakelings**
Question 1: ***Units of Measurement and Conversions*** [12]

1.1 Die afmetings van 'n kamer is 234 cm x 45 dm x 1.88 x 10^3 mm. Die digtheid van die lug in die kamer is 1.19 g.ℓ^{-1} by 25°C. Bereken die massa van die lug in die kamer in kg.

The dimensions of a room are 234 cm x 45 dm x 1.88 x 10^3 mm. The density of the air in this room is 1.19 g.ℓ^{-1} at 25°C. Calculate the mass of the air in this room in kg.

[5]

Volume of the room

$= \frac{234}{100}\,m \times \frac{1.88\times10^3\,m}{1000} \times \frac{45}{10}\,m$

$= 20.\ m^3$

$= 20.\ m^3 \times \left(\frac{10\,dm}{1\,m}\right)^3$

$= 2.0 \times 10^4\ dm^3$

$= 2.0 \times 10^4\ \ell$

$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$

$\Rightarrow \text{mass} = \text{density} \times \text{volume}$

$= 1.19\ \frac{g}{\ell} \times 2.0\times10^4\ \ell$

$= 2.4 \times 10^4\ g$

$= 24\ kg$

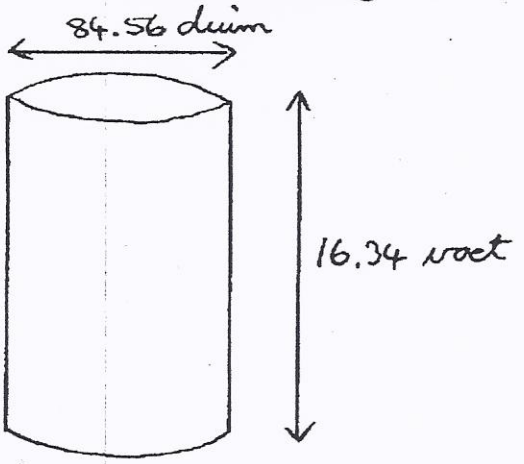
1.2 Die hoogte van 'n silindervormige tenk is 16.34 voet en dit het 'n deursnee van 84.56 duim. Dit is volledig gevul met rooiwyn. Die alkoholinhoud van die wyn is 12.25% op 'n volumebasis.

1.2.1 Bereken watter volume (in liter) suiwer alkohol is teenwoordig.

The height of a cylindrical tank is 16.34 feet and it has a diameter of 84.56 inches. It is filled completely with red wine. The alcohol content of the wine is 12.25% on a volume basis.

Calculate which volume (in liter) pure alcohol is present.

[5]



Volume van tenk

$= \pi \times r^2 \times h$ (straal om na voet)

$= \pi \times \left(\frac{84.56}{2} \times \frac{1}{12}\right)^2 \times 16.34$

$= 637.2 \text{ voet}^3$

1 duim = 2.54 cm

$= 637.2 \text{ voet}^3 \times \left(\frac{12 \text{ duim}}{1 \text{ voet}}\right)^3 \times \left(\frac{2.54 \text{ cm}}{1 \text{ duim}}\right)^3 \times \left(\frac{1 \text{ dm}}{10 \text{ cm}}\right)^3$

$= 1.804 \times 10^4 \text{ dm}^3$ voet → dm = duim → cm → dm

$= 1.804 \times 10^4 \text{ l}$

Volume alkohol = volume v. tenk × % alkohol

$= 1.804 \times 10^4 \times 0.1225$

$= 2210. \text{ l}$ (of $2.210 \times 10^3 \text{ l}$)

1.2.2 Bereken hoeveel bottels rooiwyn kan uit hierdie tenk gevul word. Die volume van een bottel is 750. cm^3.

Calculate how many bottles of red wine can be filled from this tank. The volume of one bottle is 750. cm^3.

[2]

Volume van wyn $= 1.804 \times 10^4 \text{ l}$

Volume van 1 bottel $= 750. \text{ cm}^3 \times \left(\frac{1 \text{ dm}}{10 \text{ cm}}\right)^3$

$= 0.750 \text{ dm}^3 = 0.750 \text{ l}$

$\Rightarrow$ aantal bottels $= \frac{1.804 \times 10^4}{0.750} = 2.40 \times 10^4$

$\frac{\text{volume wyn}}{\text{volume v. 1 bottel}}$

[3]

Vraag 2 Chemiese Formules en Samestelling
Question 2: Chemical Formulas and Composition [20]

2.1 'n Verbinding bestaan uit slegs C, H, O en S. Wanneer 7.3214 g van hierdie verbinding volledig in suurstof verbrand word, word die volgende produkte verkry:
11.0212 g $CO_2(g)$, 2.7076 g $H_2O(g)$ en 4.0103 g $SO_3(g)$.
Dit is ook bekend dat die molêre massa van hierdie verbinding 584.72 g/mol is.
Bereken die empiriese en molekulêre formules van hierdie verbinding.

A compound consists of only C, H, O and S. When 7.3214 g of this compound is fully combusted in oxygen gas, the following products are formed:
11.0212 g $CO_2(g)$, 2.7076 g $H_2O(g)$ and 4.0103 g $SO_3(g)$.
It is also known that the molar mass of this compound is 584.72 g/mol.
Calculate the empirical and molecular formulas of this compound.

[12]

$$C_xH_yO_zS_A + O_2 \longrightarrow CO_2 + H_2O + SO_3$$

7.3214 g → 11.0212 g, 2.7076 g, 4.0103 g

C: $n(CO_2) = \frac{11.0212}{44.01} = 0.250425$ mol

$\Rightarrow n(C) = 0.250425$ mol

$\Rightarrow$ massa (C) $= 0.250425 \times 12.01 = 3.00760$ g

H: $n(H_2O) = \frac{2.7076}{18.02} = 0.150255$ mol

$\Rightarrow n(H) = 0.150255 \times 2 = 0.300511$ mol

$\Rightarrow$ massa (H) $= 0.300511 \times 1.01 = 3.03516$ mol

S: $n(SO_3) = \frac{4.0103}{80.07} = 0.050085$ mol

$\Rightarrow n(S) = 0.050085$ mol

$\Rightarrow$ massa (S) $= 0.050085 \times 32.07 = 1.606224$ g

O: massa (O) $= (7.3214 - 3.00760 - 0.303516 - 1.606224)$ g
$= 2.404069$ g

$n(O) = \frac{2.404069}{16.00} = 0.150254$

$\Rightarrow C_{0.250425}H_{0.300511}O_{0.150254}S_{0.050085} \equiv C_5H_6O_3S_1$

$M(C_5H_6O_3S) = 146.18$ g.mol^{-1}.

$\Rightarrow$ faktor $= \frac{584.72}{146.18} = 4$ (verpaanbaar) $\Rightarrow$ molekulêre formule: $(C_5H_6O_3S) \times 4$

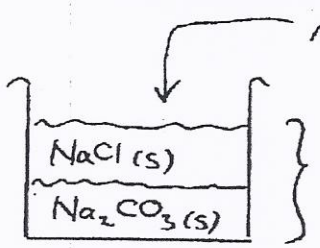
$C_{20}H_{24}O_{12}S_4$

empiries

2.2 'n Mengsel bestaan uit natriumkarbonaat-kristalle en natriumchloried-kristalle. Die totale massa van die mengsel is 46.27 g.
Wanneer hierdie mengsel verhit word by 120°C vir 24 uur verlaag die massa van die mengsel tot 30.30 g. Tydens die verhitting verval al die natriumkarbonaat na natriumoksied en koolstofdioksiedgas. Die natriumchloried bly onveranderd.
Bereken hieruit die persentasie natriumchloried in die oorspronklike mengsel.

A mixture consists of sodium carbonate crystals and sodium chloride crystals. The total mass of the mixture is 46.27 g.
When this mixture is heated at 120°C for 24 hours, the mass drops to 30.30 g.
During the heating, all the sodium carbonate decomposes to sodium oxide and carbon dioxide gas. The sodium chloride remains unchanged.
From this, calculate the percentage sodium chloride in the original mixture.

[8]



46.27 g to 30.30 g

$\Rightarrow$ change = 15.97 g

Change : $NaCl_{(s)} \xrightarrow{\Delta} NaCl_{(s)}$ (no change)

$Na_2CO_{3(s)} \xrightarrow{\Delta} Na_2O_{(s)} + CO_{2(g)}$

15.97 g

$\Rightarrow n(CO_2) = \frac{15.97}{44.01} = 0.3629$ mol (gebalanseerde massa; molverhouding)

$\Rightarrow n(Na_2CO_3)$ in mixture $= 0.3629$ (the ratio is 1 : 1)

$\Rightarrow$ mass (Na_2CO_3) in mixture $= 0.3629 \times 105.99$

$= 38.46$ g

$\Rightarrow$ mass $(NaCl)$ in mixture $= (46.27 - 39.46)$ g

$= 7.81$ g

$\Rightarrow$ % NaCl $= \frac{7.81}{M\,46.27} \times 100 = 16.9$ %

Vraag 3 **Stoigiometrie**
Question 3: ***Stoichiometry***

[4] [14]

Ammoniak reageer met suurstofgas om stikstofdioksied en water te lewer:	Ammonia reacts with oxygen gas to form nitrogen dioxide and water:

$$4NH_3(g) + 7O_2(g) \rightarrow 4NO_2(g) + 6H_2O(g)$$

	125.0 g ammoniak en 375.0 g suurstofgas word gemeng en toegelaat om te reageer.	125.0 g of ammonia and 375.0 g of oxygen gas are mixed and allowed to react.
3.1	Bereken die massa water wat gevorm word. Neem aan dat die opbrengs 100% is.	Calculate what mass of water is formed. Assume that the percent yield is 100%

[7]

1. Determine the limiting reactant.
(Any method is acceptable)
Assume O_2 is the limiting react
$\Rightarrow$ all of the O_2 react.
$\Rightarrow$ 375.0 g of O_2 react
$\Rightarrow \left(\frac{375.0}{32.00} \times \frac{4}{7} \times 17.04\right)$ g of NH_3 will be needed.
$= 114.1$ g
$\Rightarrow$ This is possible, since 125.0 g NH_3 is available.
$\Rightarrow$ assumption correct. O_2 is the limiting reactant.

2. 7 moles of O_2 yield 6 moles of H_2O
1 $\qquad\qquad$ $\frac{6}{7}$
$\left(\frac{375.0}{32.00}\right)$ $\qquad$ $\left(\frac{6}{7} \times \frac{375.0}{32.00}\right)$ $n(O_2)$
$= 10.04$ moles of H_2O

$\Rightarrow$ mass of water $= 10.04 \times 18.04$
$= 181.2$ g

3.2 Bereken watter massa suurstofgas word benodig om 625g $NO_2(g)$ te vorm. Dit is bekend dat die persentasie opbrengs t.o.v. NO_2 slegs 34.5% is.

Calculate which mass of oxygen gas is required to form 625 g of $NO_2(g)$. It is known that the percent yield with respect to $NO_2(g)$ is only 34.5%.

[7]

625 g NO_2 must be formed.

⇒ plan for more, since the yield is only 34.5 %

⇒ plan for x g NO_2

⇒ 34.5 % of x = 625 g

⇒ $x = \frac{625}{0.345} = 1.81 \times 10^3$ g NO_2

$$4\,NH_3 + 7\,O_2 \longrightarrow 4\,NO_2 + 6\,H_2O$$

? ← (625 g, 1.81×10^3 g)

4 moles of NO_2 are formed from 7 moles O_2

1 : $\frac{7}{4}$

$\left(\frac{1.81 \times 10^3}{46.01}\right)$ moles $n(NO_2)$: $\left(\frac{7}{4} \times \frac{1.81 \times 10^3}{46.01}\right)$

$= 68.9$ moles

⇒ mass of $O_2 = 68.9 \times 32.00$

$= 2.20 \times 10^3$ g

Vraag 4 Waterige Oplossings
Question 4: Aqueous Solutions **[16]**

[5]

4.1 Skryf en voltooi die volgende chemiese reaksievergelykings. Skryf die fases by elke chemiese spesie en balanseer die vergelykings.	Write and complete the following chemical reaction equations. Write the phase of each chemical species and balance the equations.
Waterige oplossings van die volgende word in elke geval saamgevoeg:	Aqueous solutions of the following are added together in each case:
4.1.1 Swaelsuur en aluminiumhidroksied.	Sulphuric acid and aluminium hydroxide.

[3]

$3H_2SO_{4(aq)} + 2Al(OH)_{3(aq)} \longrightarrow 6H_2O_{(l)} + Al_2(SO_4)_{3(\ )}$

4.1.2 Salpetersuur en natriumsulfied.	Nitric acid and sodium sulphide.

[3]

$2HNO_{3(aq)} + Na_2S_{(aq)} \longrightarrow H_2S_{(g)} + 2NaNO_{3(aq)}$

4.1.3 Perchloorsuur en magnesiumbikarbonaat.	Perchloric acid and magnesium bicarbonate.

[3]

$2HClO_{4(aq)} + Mg(HCO_3)_{2(aq)} \longrightarrow 2CO_{2(g)} + 2H_2O_{(l)} + Mg(ClO_4)_{2(aq)}$

4.1.4 Ammoniumfosfaat en kalsiumnitraat	Ammonium phosphate and calcium nitrate.

[3]

$2(NH_4)_3PO_{4(aq)} + 3Ca(NO_3)_{2(aq)} \longrightarrow Ca_3(PO_4)_{2(s)} + 6NH_4NO_{3(a}$

4.2 Beskryf in woorde (kortliks) en met chemiese reaksievergelykings hoe u silwer(I)sulfied-kristalle sal berei, deur waterige oplossings saam te voeg en dan te filtreer.	Describe in words (briefly) and with chemical reaction equations how you would prepare silver(I) sulphide crystals, by combining aqueous solutions and then filtration.

[4]

Add the following two solutions:

1. Any soluble Ag^+ salt, like $AgNO_3$, $AgClO_4$.
2. Any soluble S^{2-} salt, like Na_2S, $(NH_4)_2S$

Then: $2Ag^+_{(aq)} + S^{2-}_{(aq)} \longrightarrow Ag_2S_{(s)}$

Filter off the precipitate.

CMY 117 / 2008

Semestertoets 1

5 Maart 2008

Memorandum: Afdeling B

CMY 117 / 2008

Semester Test 1

5 March 2008

Memorandum: Section B

Vraag / Question	
1	D
2	B
3	C
4	D
5	A of/or C
6	C
7	B
8	A
9	B
10	B
11	C
12	E
13	C
14	E
15	B
16	C
17	A
18	E
19	C