POSSIBLE ANSWERS - OCT / NOV 2006

SENIOR CERTIFICATE EXAMINATIONS

PHYSICAL SCIENCE PAPER 2 HG NOV 2006
NATUUR- EN SKEIKUNDE VRAESTEL 2 HG NOV 2006

General Marking Rule/*Algemene nasien reël*
If incorrect charges are written or if charges are ommitted – penalise **ONE** mark in a question
*As verkeerde ladings gebruik word of as ladings weg gelaat word – penaliseer **EEN** punt in 'n vraag*

QUESTION 1/ *VRAAG 1*

1.1	B	1.2	A	1.3	C	1.4	B	1.5	D	
1.6	D	1.7	C	1.8	D	1.9	C	1.10	A	
1.11	D	1.12	C	1.13	A	1.14	B	1.15	B	4 x 15 = **[60]**

SECTION B/ *AFDELING B*

QUESTION 2/ *VRAAG 2*

2.1

2.1.1 Hydrogen bonding ✓
Waterstofbinding (1)

2.1.2 Van der Waals forces ✓ (Accept London forces, dispersion forces, momentary dipole- induced dipole.)
Van der Waalskragte (Aanvaar Londen kragte, dispersie-kragte, momentele dipool- geïnduseerde dipool.) (1)

2.2 Pressure (on the gas) ✓
Druk (op die gas) (1)

2.3 Plunger is free to move ✓ ✓ (to equalise the gas pressure inside the syringe with the external pressure.)
Die suier is vry om te beweeg (om gasdruk binne die buis met die eksterne druk te egaliseer .) (2)

2.4 ✓ ✓
No significant change can be observed in temperature/pressure/volume.
(1 minute intervals are too short $\frac{1}{2}$)
Geen opmerkbare verandering in temp/volume/druk kan waargeneem word.
(1-minuut intervalle is te kort $\frac{1}{2}$) (2)

2.5

2.5.1 0 °C / 273 K ✓ (1)

2.5.2

2.5.2.1 (At 80 °C) nitrogen behaves like an ideal gas. ✓ ✓
OR
(Since temperature is moderately high), volume is directly proportional to (Kelvin) temperature. /Graph is still a straight line/ $V\alpha T$ / $V\alpha \Delta t$ /
Gradient constant

(By 80 °C) sal die stikstofgas soos 'n ideale gas optree.
OF
(Aangesien temperatuur aansienlik hoog is), is volume direk eweredig aan die (Kelvin) temperatuur/ Grafiek is steeds 'n reguit lyn/ $V\alpha T$ $V\alpha \Delta t$ /
Gradient konstant (2)

2.5.2.2

OPTIONAL
At this temperature intermolecular forces become very significant ✓
By hierdie temperatuur speel die intermolekulêre kragte 'n betekenisvolle rol.

The gas will liquefy before this temperature is reached. ✓✓
Die gas sal vervloei voordat die temperatuur bereik word.
OR / OF
At this temperature the gas deviates from ideal behaviour
By hierdie temperatuur vanaf ideale gedrag.
OR/*OF*
$N_2(g)$ freezes at –210 °C ∴No more gas
$N_2(g)$ vries by –210°C∴Geen gas teenwoordig

(2)

2.5.2.3 $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ OR $\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$ but $p_1 = p_2$ ✓

$\therefore \frac{42,9}{293} = \frac{V_2}{353}$ ✓ $\therefore V_2 = 51,7\ cm^3$ ✓

Mark for temperature conversion only if used in the equation. Rule: 16.2.4.
Punt vir temperatuur omskakeling slegs as in die vergelyking gebruik is. Reël 16.2.4.

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ ✓

✓ $\frac{48,8}{333} = \frac{V_2}{353}$ ✓

$V_2 = 51,7cm^3$ ✓

OR

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ ✓

✓ $\frac{40}{273} = \frac{V_2}{353}$ ✓

$V_2 = 51,7cm^3$ ✓

OR

Any set of values that result in 51,7 cm^3/
Enige stel waardes wat eindig in 51,7 cm^3

(4)

Gradient $= \frac{\Delta V}{\Delta t} = \frac{48,8 - 42,9}{60 - 20} = 0,1475$ ✓ ✓

$\therefore \frac{x - 48,8}{80 - 60} = 0,1475$ ✓

$\therefore x = 51,7cm^3$ ✓

2.6 pV = nRT ✓

✓ ✓ ✓ ✓
$250 \times 10^3 \times V = (0,71 \times 10^3/71) \times 8,31 \times (300)$

$V = 0,099\ m^3$ ✓

R must be **8,31**
*R moet **8,31** wees*

OR

pV = nRT ✓

✓ ✓ ✓ ✓ ✓
$250 \times 10^3 \times V = 10 \times 8,31 \times (300)$
$V = 0,099\ m^3$ ✓

$n = \frac{m}{M}$ ✓

$n = \frac{0,71 \times 10^3}{71}$

$n = 10\ mol$ ✓

(7)

[23]

QUESTION 3 / *VRAAG 3*

3.1

3.1.1 $2SO_2 + O_2 \rightarrow 2SO_3$ (✓ for balancing/ *vir balansering*) (2)

(⇌ accepted/*aanvaar*)

3.1.2 Step 2 ✓ (1)

3.1.3 Vanadium pentoxide / Platinised asbestos/ Iron(III) oxide✓ ✓
Vanadiumpentokdied / Geplatineerde asbes/ Yster (III) oksied (2)

(If/*As* V_2O_5 ($\frac{1}{2}$))

Accept: Platinum (2/2)
Aanvaar: Platinum

3.1.4 Any **ONE** of: Fine mist of sulphuric acid is formed / Highly exothermic reaction / Partially soluble in water. ✓ ✓

Accept: Insoluble (2/2)
Aanvaar: Onoplosbaar

*Enige **EEN** van: Fyn swawelsuurmis word gevorm / Hoogs eksotermiese reaksie / Gedeeltelik oplosbaar in water.* (2)

3.1.5 Dehydrating agent /Dehydrating property✓ ✓
Dehidreermiddel/ Dehidreervermoë (2)

3.2

3.2.1 O_2 (accept O / *aanvaar O*)✓ ✓ (2)

3.2.2 Hypochlorous acid OR hypochlorite ion OR O in HOCℓ ✓ ✓
Hipochloorsuur / hipochlorietioon (onderchloorigsuur) of O in HOCℓ (2)

(HOCℓ / $OC\ell^-$ ($\frac{1}{2}$))

Accept: HCℓO
Aanvaar:

3.2.3 $C\ell_2 + H_2O \rightarrow HOC\ell + HC\ell$ (✓ balancing / *balansering*) (3)

⇌ accepted/*aanvaar*

[16]

QUESTION 4/*VRAAG 4*

4.1

4.1.1 **Any two of / *Enige twee van*:**
Colourless solution turns greenish/blue
Die kleurlose oplossing verander na groenerig/blou
OR/*OF*
Brown gas / bubbles formed in the solution
Bruin gas /-borrels word in die oplossing gevorm.
OR/*OF*
Temperature increases (exothermic reaction)/Test tube feels warm
Die temperatuur neem toe (eksotermiese-reaksie)/Proefbuis voel warm.
OR/*OF*
Copper dissolves/dissappear
Koper los op/ verdwyn (2 x ✓) (2)

4.1.2 Brown gas / NO_2 (is collected)./A lighter gas with sharp irritating smell ✓ (1)
Bruin gas / NO_2 (word opgevang)./'n Ligter gas met skerp irriterende reuk

4.2 Cu^{2+} ✓✓ (Copper (II) / *Koper(II)* (½)) (2)

4.3 Redox/ *Redoks* ✓✓ (2)

4.4 The NO_2 dissolved in H_2O ✓ and therefore pressure inside the test tube is less than the pressure outside./partial vacuum forms✓
Die NO_2 los in H_2O op en daarom sal die druk in die proefbuis minder as die druk buite wees./gedeeltelike vakuum vorm (2)

4.5 Acidic / *Suur* ✓✓ (2)

4.6

4.6.1 $NO_3^- + 4\,H^+ + 3\,e^- \rightarrow NO + 2H_2O$ ✓✓

If / as: $NO_3^- + 4\,H^+ + 3\,e^- \rightleftharpoons NO + 2H_2O$	(1/2)
If / as: $NO_3^- + 4\,H^+ + 3\,e^- \longleftarrow NO + 2H_2O$	(0/2)
If / as: $NO + 2H_2O \longleftarrow NO_3^- + 4\,H^+ + 3\,e^-$	(1/2)
If / as: $NO + 2H_2O \rightleftharpoons NO_3^- + 4\,H^+ + 3\,e^-$	(0/2)

(2)

4.6.2 $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$ (Balance ✓ *Balansering*)
OR/ *OF*
$3Cu + 2NO_3^- + 8H^+ \rightarrow 3Cu^{2+} + 2NO + 4H_2O$ (3)

$\rightleftharpoons$ only/*slegs* ⅔

[16]

QUESTION 5/*VRAAG 5*

5.1 $CaCO_3 + 2HC\ell \rightarrow CaC\ell_2 + H_2O + CO_2$ (✓ balancing/*balansering*) (3)

$CaCO_3 + 2HC\ell \rightarrow CaC\ell_2 + H_2CO_3$ ($^2/_3$)

5.2 0,5 g ✓✓ (0,5 only/ *slegs* ✓) (2)

5.3 2 - 4 minutes */2 - 4 minute* ✓✓ (2)

5.4 5 minutes / *5 minute* ✓✓ (Unit not required/ *Eenheid nie nodig)* (2)

5.5

5.5.1 Increases */ Neem toe* ✓✓ (2)

5.5.2 Stays the same */ Bly dieselfde* ✓✓ (2)

5.6 P ✓✓ (2)

[15]

QUESTION 6/*VRAAG 6*

6.1 Assume the $n_{(SO3)}$ = x at equilibrium ✓

Neem aan die $n_{(SO3)}$ = x by ewewig

∴Mol SO_2 = 2-x and / *en* mol NO_2 = 2-x and / *en mol* NO = x ✓

∴$[SO_2] = [NO_2] = (2-x)/2$ mol.dm^{-3} ✓

∴$[SO_3] = [NO] = x/2$ mol.dm^{-3}

$$K_c = \frac{[SO_3][NO]}{[SO_2][NO_2]} = 9 \quad (\checkmark)$$

$$\therefore \frac{\frac{x}{2}\cdot\frac{x}{2}}{\frac{(2-x)}{2}\cdot\frac{(2-x)}{2}} = 9 \quad (\checkmark\ \checkmark) \qquad \therefore x^2 = 9(2-x)^2$$

∴x = 3(2-x) = 6 - 3x

∴4x = 6

∴x = 1,5 mol ✓

No ✓ because there is more SO_3 required at equilibrium ✓ /

Nee, omdat daar meer SO_3 benodig word by ewewig

(9)

IF THE FOLLOWING PROCEDURE IS FOLLOWED:

Assume the system is in equilibrium ✓✓

Aanvaar die sisteem is in ewewig

If no assumption: max 7
Indien geen aanname: maks 7

	NO_2	SO_2	SO_3	NO
Molar ratio /*Molverhouding*	1	1	1	1
Initial quantity (mol)/ *Aanvangshoeveelheid*	2	2	0	0
Change (mol) /*Verandering (mol)*	-0,75	-0,75	+0,75	+0,75
Quantity at **t** (mol) / *Hoeveelheid by **t** (mol)*	1,25	1,25	0,75	0,75
Concentration (mol.dm^{-3}) / *Konsentrasie (mol.dm^{-3})*	0,625✓	0,625✓	0,375✓	0,375✓

4 Marks are allocated for quantity at t **OR** Concentration calculations
*4 Punte toegeken vir hoeveelheid by t **OF** Konsentrasie berekeninge*

$$K_c = \frac{[SO_3].[NO]}{[SO_2].[NO_2]}$$

$$= 0,375^2 / 0,625^2$$

$$= 0,36 \quad \checkmark$$

No ✓ because K is not equal to 9 ✓ .

6.2 Increase in K_c implies forward reaction was favoured. ✓

Toename in K_c beteken dat voorwaartse reaksie bevoordeel was.

Increase in temperature favours an endothermic reaction. ✓

Toename in temperatuur bevoordeel die endotermiese reaksie.

Forward reaction is endothermic ✓✓

Die voorwaartse reaksie is endotermies.

(4)

[13]

QUESTION 7/*VRAAG 7*

7.1 A solution with a low concentration of H^+-ions in comparison to water ✓✓ (2)
'n Oplossing met 'n lae konsentrasie van H^+-ione en vergelyking met water.
OR/*OF*
More water than H^+- ions
Meer water as H^+-ione

7.2.1 OH^- ✓ (1)

7.2.2 $pH = -\log [H^+] = 12,8$ ✓
$\therefore [H^+] = 1,58 \times 10^{-13}$ or $10^{-12,8}$ ✓
$[H^+]x[OH^-] = 1 \times 10^{-14}$ ✓
$\therefore [OH^-] = 0,063$ mol.dm^{-3} ✓

$pH + pOH = 14$ ✓
$12,8 + pOH = 14$ ✓
$\therefore pOH = 1,2$ ✓ ✓
$\therefore [OH^-] = 10^{-1,2} = 0,063$ mol.dm^{-3}

✓ ✓
$n = cxV = 0,063 \times 0,15 = 9,45 \times 10^{-3}$ mol
✓ (7)

7.2.3
✓
$n = cxV = 0,2 \times 0,05 = 0,01$ mol ✓
$(H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O)$
$\therefore 0,01$ mol H_2SO_4 ✓ : 0,02 mol KOH ✓
Therefore 0,02 mol KOH was neutralised
Dus 0,02 mol KOH is geneutraliseer.

+ +

$\therefore$ Total / *Totale* mol KOH = 0,02 + 0,0094 = 0,029 mol ✓ (0,03 mol)

✓ ✓
$m = nxM = 0,029 \times 56 = 1,62$ g ✓
(Approximation / *benadering*: 1,6 g or / *of* 1,7 g) (8)

✓ ✓ ✓
$m_{KOH} = c \times V \times M = 0,063 \times 0,15 \times 56 = 0,53$g
✓ ✓ ✓
$n_{H_2SO_4} = cxV = 0,2x0,05 = 0,01$mol
0,01 mol H_2SO_4 reacts with/*reageer met* 0,02 mol KOH
✓ ✓
$m_{KOH} = n \times M = 0,02 \times 56 = 1,12$g $\therefore m_{KOH} = (0,53 + 1,12) = 1,65$ g

7.3
7.3.1 Acidic ✓✓ / *Suur* (2)

7.3.2 ✓ ✓
$NH_4^+ + H_2O \rightleftharpoons NH_3 + H_3O^+$ (✓ balancing / *balansering*)
$NH_4NO_3 + H_2O \rightleftharpoons NH_4OH + HNO_3$ (max $^2/_3$)
(3)

Accept single arrow / *Aanvaar enkel pyltjie.*

[23]

QUESTION 9/*VRAAG 9*

9.1

9.1.1 B (CH_3COOH) ✓✓ (2)

9.1.2 C (C_2H_5OH) ✓✓ (2)

9.1.3 D (C_2H_4) ✓✓ (2)

9.1.4 C (C_2H_5OH) ✓✓ (2)

9.1.5 A ($CHC\ell_3$) ✓✓ (2)

9.2

9.2.1 Increases ✓✓ / *Neem toe* (2)

9.2.2 Increase in molecular mass/size ✓

implies an increase in intermolecular force ✓

more energy is required to break the bonds✓

Toename in molekulêre grootte
impliseer 'n toename in intermolekulêre-kragte
Meer energie benodig om die kragte te oorkom (3)

9.2.3 A ✓ (1)

9.2.4 Saturated hydrocarbons have a higher molar mass ✓

therefore stronger intermolecular forces ✓

more energy required to overcome forces /therefore higher boiling point ✓

Versadigde koolwaterstowwe het groter molêre massa
dus sterker intermolekulêre kragte
dus hoër kookpunte/meer energie benodig om kragte te oorkom (3)

[19]

TOTAL/*TOTAAL*: 200