

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 omitted – 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 |

$$4 \times 15 = [60]$$

SECTION B/ AFDELING B

QUESTION 2/ VRAAG 2

2.1

- 2.1.1 Hydrogen bonding ✓ (1)
Waterstofbinding

- 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) ✓ (1)
Druk (op die gas)

- 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. (2)
(1-minuut intervalle is te kort $\frac{1}{2}$)

2.5

- 2.5.1 $0^{\circ}\text{C} / 273\text{ K}$ ✓ (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/ $V \propto T$ / $V \propto \Delta t$ / 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/ $V \propto T$ / $V \propto \Delta t$ / 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 vervloeи 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

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad \text{OR} \quad \frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2} \quad \text{but } p_1 = p_2$$

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

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. Reel 16.2.4.

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad \checkmark$$

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

$$V_2 = 51,7 \text{ cm}^3 \quad \checkmark$$

OR

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad \checkmark$$

$$\frac{40}{273} = \frac{V_2}{353} \quad \checkmark$$

$$V_2 = 51,7 \text{ cm}^3 \quad \checkmark$$

OR

Any set of values that
result in $51,7 \text{ cm}^3$ /
Enige stel waardes wat
eindig in $51,7 \text{ cm}^3$

(4)

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

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

$$\therefore x = 51,7 \text{ cm}^3$$

2.6

$$pV = nRT \quad \checkmark$$

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

$$V = 0,099 \text{ m}^3 \quad \checkmark$$

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

OR

$$pV = nRT \quad \checkmark$$

$$250 \times 10^3 \times V = 10 \times 8,31 \times (300)$$

$$V = 0,099 \text{ m}^3 \quad \checkmark$$

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

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

$$n = 10 \text{ mol} \quad \checkmark$$

(7)

[23]

QUESTION 3 / VRAAG 3

3.1



(⇒ accepted/aanvaar)

3.1.2 Step 2 ✓ (1)

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

(If/As $\text{V}_2\text{O}_5 (\frac{1}{2})$)

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)

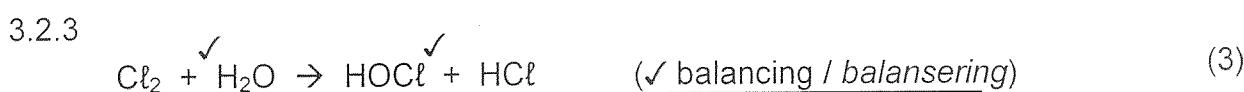
3.2

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

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

$(\text{HOCl} / \text{OCl}^- (\frac{1}{2}))$

Accept: HClO
Aanvaar:



⇒ 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 / NO₂ (is collected)./A lighter gas with sharp irritating smell ✓ (1)

Bruin gas / NO₂ (word opgevang)./n Ligter gas met skerp irriterende reuk

4.2 Cu²⁺ ✓ ✓ (Copper (II) / Koper(II)) (½) (2)

4.3 Redox/ Redoks ✓ ✓ (2).

4.4 The NO₂ dissolved in H₂O ✓ and therefore pressure inside the test tube is less than the pressure outside./partial vacuum forms✓

Die NO₂ los in H₂O 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 NO₃⁻ + 4 H⁺ + 3 e⁻ → NO + 2H₂O ✓ ✓

If / as: NO₃⁻ + 4 H⁺ + 3 e⁻ ⇌ NO + 2H₂O (1/2)

If / as: NO₃⁻ + 4 H⁺ + 3 e⁻ ← NO + 2H₂O (0/2)

If / as: NO + 2H₂O ← NO₃⁻ + 4 H⁺ + 3 e⁻ (1/2)

If / as: NO + 2H₂O ⇌ NO₃⁻ + 4 H⁺ + 3 e⁻ (0/2)

(2)

4.6.2 3Cu + 8HNO₃ → 3Cu(NO₃)₂ + 2NO + 4H₂O (Balance ✓ Balansering)

OR/ OF

3Cu + 2NO₃⁻ + 8H⁺ → 3Cu²⁺ + 2NO + 4H₂O

⇒ only/slegs 2/3

[16]

QUESTION 5/VRAAG 5

- 5.1 $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$ (✓ balancing/balansering) (3)
 $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{CO}_3$ ($\frac{2}{3}$)
- 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 $n_{(SO_3)} = x$ at equilibrium ✓

Neem aan die $n_{(SO_3)} = x$ by ewewig

∴ Mol SO₂ = 2-x and / en mol NO₂ = 2-x and / en mol NO = x ✓

$$\therefore [SO_2] = [NO_2] = (2-x)/2 \text{ mol.dm}^{-3} \checkmark$$

$$\therefore [SO_3] = [NO] = x/2 \text{ mol.dm}^{-3}$$

$$K_c = \frac{[SO_3][NO]}{[SO_2][NO_2]} = 9 \quad \therefore \frac{\frac{x}{2} \cdot \frac{x}{2}}{(2-x) \cdot (2-x)} = 9 \quad \therefore x^2 = 9(2-x)^2$$

$$\therefore x = 3(2-x) = 6 - 3x$$

$$\therefore 4x = 6$$

$$\therefore x = 1,5 \text{ mol} \checkmark$$

No ✓ because there is more SO₃ required at equilibrium ✓ /

Nee, omdat daar meer SO₃ benodig word by ewewig

(9)

IF THE FOLLOWING PROCEDURE IS FOLLOWED:

Assume the system is in equilibrium ✓ ✓

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

Aanvaar die sisteem is in ewewig

	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✓

$$K_c = \frac{[SO_3].[NO]}{[SO_2].[NO_2]} \\ = \frac{0,375^2}{0,625^2} \\ = 0,36 \checkmark$$

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

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 bevordeel was.

Increase in temperature favours an endothermic reaction. ✓

Toename in temperatuur bevordeel 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 ✓✓
 'n Oplossing met 'n lae konsentrasie van H⁺-ione en vergelyking met water. (2)

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 ✓
 ∴ [H⁺] = 1,58 × 10⁻¹³ or 10^{-12,8} ✓
 [H⁺] × [OH⁻] = 1 × 10⁻¹⁴ ✓
 ∴ [OH⁻] = 0,063 mol·dm⁻³ ✓

$$\begin{aligned} \text{pH} + \text{pOH} &= 14 \quad \checkmark \\ 12,8 + \text{pOH} &= 14 \quad \checkmark \\ \therefore \text{pOH} &= 1,2 \quad \checkmark \\ \therefore [\text{OH}^-] &= 10^{-1,2} = 0,063 \text{ mol}\cdot\text{dm}^{-3} \end{aligned}$$

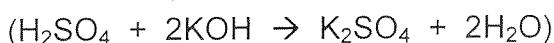
\downarrow

n = cxV = 0,063 × 0,15 = 9,45 × 10⁻³ mol ✓

(7)

7.2.3

n = cxV = 0,2 × 0,05 = 0,01 mol ✓



∴ 0,01 mol H₂SO₄ ✓ : 0,02 mol KOH ✓

Therefore 0,02 mol KOH was neutralised

Dus 0,02 mol KOH is geneutraliseer.

∴ Total / Totale mol KOH = 0,02 + 0,0094 = 0,029 mol ✓ (0,03 mol)

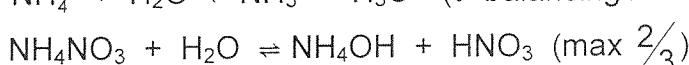
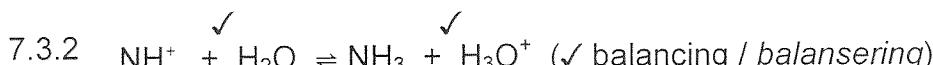
✓ ✓
 m = nxM = 0,029 × 56 = 1,62 g ✓

(Approximation / benadering: 1,6 g or / of 1,7 g) (8)

$$\begin{aligned} m_{\text{KOH}} &= c \times V \times M = 0,063 \times 0,15 \times 56 = 0,53 \text{ g} \quad \checkmark \\ n_{\text{H}_2\text{SO}_4} &= c \times V = 0,2 \times 0,05 = 0,01 \text{ mol} \quad \checkmark \\ 0,01 \text{ mol H}_2\text{SO}_4 &\text{ reacts with/reageer met } 0,02 \text{ mol KOH} \quad \checkmark \\ m_{\text{KOH}} &= n \times M = 0,02 \times 56 = 1,12 \text{ g} \quad \therefore m_{\text{KOH}} = (0,53 + 1,12) = 1,65 \text{ g} \end{aligned}$$

7.3

7.3.1 Acidic ✓✓ / Suur (2)



(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 ($\text{C}_2\text{H}_5\text{OH}$) ✓✓ (2)
- 9.1.3 D (C_2H_4) ✓✓ (2)
- 9.1.4 C ($\text{C}_2\text{H}_5\text{OH}$) ✓✓ (2)
- 9.1.5 A (CHCl_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 oorkon,

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 hoér kookpunte/meer energie benodig om kragte te oorkom

[19]

TOTAL/TOTAAL: 200