basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 11

PHYSICAL SCIENCES: CHEMISTRY (P2)
FISIESE WETENSKAPPE: CHEMIE (V2)

NOVEMBER 2019

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

These marking guidelines consist of 14 pages./
Hierdie nasienriglyne bestaan uit 14 bladsye.

Please turn over/*Blaai om asseblief*

QUESTION 1/*VRAAG 1*

1.1	A ✓✓	(2)
1.2	B ✓✓	(2)
1.3	D ✓✓	(2)
1.4	D ✓✓	(2)
1.5	C ✓✓	(2)
1.6	D ✓✓	(2)
1.7	A ✓✓	(2)
1.8	D ✓✓	(2)
1.9	B ✓✓	(2)
1.10	A ✓✓	(2)
		[20]

QUESTION 2/*VRAAG 2*

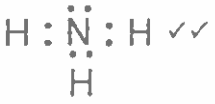
2.1

2.1.1

Marking guidelines/*Nasienriglyne*
If any of the underlined key words/phrases are omitted: minus 1 mark
Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is: minus 1 punt

Two electrons shared between two atoms in a covalent bond. ✓✓
Twee elektrone gedeel tussen twee atome in 'n kovalente binding. (2)

2.1.2

(a)  ✓✓

Marking guidelines/*Nasienriglyne*
- Whole structure correct./*Hele struktuur korrek.* ✓✓
- H : N : H ✓ Max./*Maks.* 1/2
  H

(2)

(b)  ✓✓

Marking guidelines/*Nasienriglyne*
- Whole structure correct./*Hele struktuur korrek.* ✓✓
- H : Cℓ : O Max./*Maks.* 1/2

(2)

2.1.3

(a) 3 ✓ (1)

(b) 2 ✓ (1)

(c) Trigonal pyramidal ✓
Trigonaal piramidaal (1)

2.1.4 O-H ✓
O-H ΔEN = 3,5 - 2,1 = 1,4
N-H ΔEN = 3 - 2,1 = 0,9 ✓

OR/*OF*
ΔEN between H and O is greater./ΔEN between N and H is smaller.
ΔEN tussen H en O is groter /ΔEN tussen N en H is kleiner. (2)

2.1.5 Hydrogen bonds ✓
Waterstofbindings (1)

2.1.6 Dative covalent bond ✓
Datief kovalente binding (1)

2.2

2.2.1

Marking guidelines/*Nasienriglyne*
If any of the underlined key words/phrases are omitted: minus 1 mark
Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is: minus 1 punt

Energy needed to break one mole of a compound's molecules into separate atoms. ✓✓
Die energie benodig om een mol molekule van 'n verbinding in aparte atome op te breek. (2)

2.2.2 A ✓
When the bond order increases/double bond is formed, the bond length decreases ✓ and the bond energy increases. ✓
Wanneer die bindingsorde verhoog/dubbelbinding gevorm word, verlaag die bindingslengte en verhoog die bindingsenergie.

OR/*OF*
When a second bond is formed, the bond length decreases ✓ and the potential energy of the molecule decreases. ✓
Wanneer die tweede binding gevorm word, verlaag die bindingslengte en verlaag die potensiële energie. (3)

2.2.3 148 pm ✓ (1)
[19]

QUESTION 3/*VRAAG 3*

3.1

Marking guidelines/*Nasienriglyne*
If any of the underlined key words/phrases are omitted: minus 1 mark
Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is: minus 1 punt

Temperature at which the solid and liquid phases of a substance are at equilibrium. ✓✓
Die temperatuur waarby die vaste- en vloeistoffases van 'n stof in ewewig is. (2)

3.2

- HF has hydrogen bonds between molecules. ✓
- HCℓ has dipole-dipole forces.✓
- Hydrogen bonds are stronger than dipole-dipole forces./*Intermolecular forces in HF stronger./ Intermolecular forces in HCℓ weaker.* ✓
- More energy is needed to overcome/break intermolecular forces. ✓

- *HF het waterstofbindings tussen molekule.*
- *HCℓ het dipool-dipoolkragte.*
- *Waterstofbindings is sterker as dipool-dipoolkragte./Intermolekulêre kragte in HF sterker./Intermolekulêre kragte in HCℓ swakker.*
- *Meer energie benodig om intermolekulêre kragte te oorkom/breek.* (4)

3.3 CS_2 ✓ (1)

3.4

- CS_2 has a greater surface area/molecular mass/larger molecules (than CO_2). ✓
- London forces increase with molecular mass/molecular size. ✓
- More energy needed to break/overcome intermolecular forces. ✓

- *CS_2 has a groter oppervlak/molekulêre massa/groter molekule (as CO_2).*
- *Londonkragte neem toe met molekulêre massa/molekulêre grootte.*
- *Meer energie benodig om intermolekulêre kragte te oorkom/breek.* (3)

3.5 HCℓ ✓
Lowest boiling point. ✓
Laagste kookpunt. (2)
[12]

QUESTION 4/*VRAAG 4*

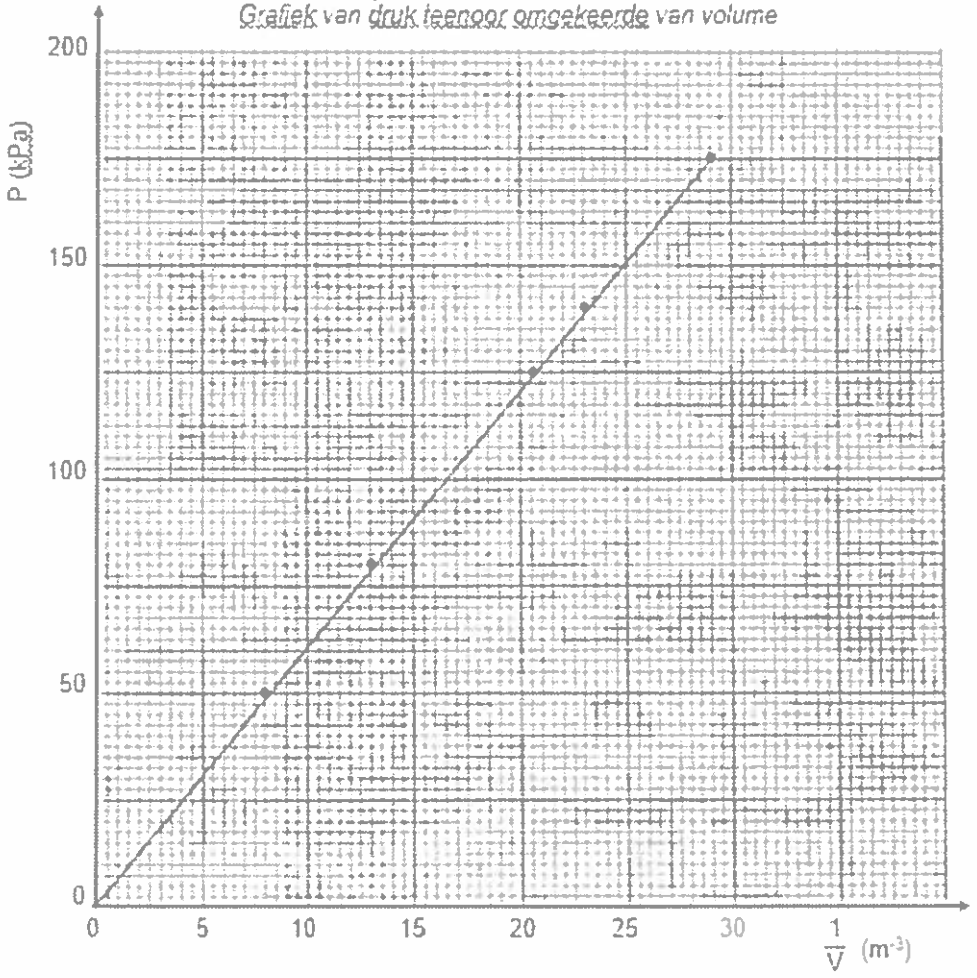
4.1

Marking guidelines/*Nasienriglyne*
If any of the underlined key words/phrases are omitted: minus 1 mark
Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is: minus 1 punt

Pressure of an enclosed gas is inversely proportional to the volume it occupies at constant temperature. ✓✓
Die druk van 'n ingeslote gas is omgekeerd eweredig aan die volume wat dit beslaan by konstante temperatuur. (2)

4.2

Graph of pressure versus inverse of volume
Grafiek van druk teenoor omgekeerde van volume



Marking criteria for graph/*Nasienriglyne vir grafiek*	
Three (3) points plotted correctly./*Drie (3) punte korrek gestip.*	✓
All 5 points correctly plotted./*Al 5 punte korrek gestip.*	✓✓
Line of best fit drawn./*Beste paslyn getrek.*	✓

Refer to the last page of marking guideline for graph drawn on supplied graph sheet./*Verwys na die laaste bladsy van nasienriglyn vir grafiek getrek op verskafde grafiekpapier.* (3)

4.3 Temperature/*Temperatuur* ✓
OR/OF
Number of moles of gas/*Aantal mol gas*

Gradient/*gradiënt* = pV = nRT ✓ (2)

4.4 Particles/molecules of real gases occupy volume. ✓
At high pressure, volume of gas molecules/particles become significant ✓ and the measured volume is greater than expected. ✓

Deeltjies/molekule van werklike gasse beslaan volume.
By hoë druk word volume van molekule/deeltjies beduidend en die gemete volume is groter as verwag. (3)

4.5 pV = nRT ✓
(125 000)(0,049) ✓ = n(8,31)(298) ✓
n = 2,47 mol ✓ (4)
[14]

QUESTION 5/*VRAAG 5*

5.1 $\frac{p_1}{T_1} = \frac{p_2}{T_2}$

$\frac{240}{303}$ ✓ = $\frac{x}{263}$ ✓

x = 208,32 (kPa) ✓ (3)

5.2 Greater than/*Groter as* ✓ (1)

5.3

Marking guidelines/*Nasienriglyne*	
• Compare gradients./*Vergelyk gradiënte.* ✓ • Gradient = $\frac{p}{T} = \frac{nR}{V}$. ✓ • Compare $\frac{1}{V}$ ✓	
OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
Gradient of graph for N smaller than gradient of graph for M./*Gradiënt van grafiek vir N kleiner as gradiënt van grafiek vir M.* ✓ Gradient = $\frac{nR}{V}$ ✓ Therefore/*Dus* $(\frac{1}{V})_N < (\frac{1}{V})_M$ ✓ Thus volume of N larger than volume of M./*Dus is die volume van N groter as die volume van M.*	Gradient (N) < *gradient (M)* ✓ $(\frac{p}{T})_N < (\frac{p}{T})_M$ $(\frac{nR}{V})_N < (\frac{nR}{V})_M$ ✓ $(\frac{1}{V})_N < (\frac{1}{V})_M$ ✓ $V_N > V_M$

(3)
[7]

QUESTION 6/*VRAAG 6*

6.1

6.1.1

Marking guidelines/*Nasienriglyne*
If any of the underlined key words/phrases are omitted: minus 1 mark
Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is: minus 1 punt

The mass of one mole of a substance measured in $g \cdot mol^{-1}$. ✓✓
Die massa van een mol van 'n stof gemeet in $g \cdot mol^{-1}$. (2)

6.1.2

$n(C) = \frac{39,13}{12}$ ✓ = 3,26

$n(H) = \frac{8,7}{1}$ ✓ = 8,7

$n(O) = \frac{52,17}{16}$ ✓ = 3,26

Ratio/*Verhouding* C : H : O:

$\frac{3,26}{3,26} = 1$
$\frac{8,7}{3,26} = 2,67$ ✓
$\frac{3,26}{3,26} = 1$

C : H : O = 1 : 2,67 : 1 = 3 : 8 : 3 ✓
Empirical formula/*Empiriese formule*:
$C_3H_8O_3$ ✓ (6)

Marking guidelines/*Nasienriglyne*
- Divide %C by 12 $g \cdot mol^{-1}$./*Deel %C deur 12 $g \cdot mol^{-1}$.*
- Divide %H by 1 $g \cdot mol^{-1}$./*Deel %H deur 1 $g \cdot mol^{-1}$.*
- Divide %O by 16 $g \cdot mol^{-1}$./*Deel %O deur 16 $g \cdot mol^{-1}$.*
- Divide by smallest answer/*Deel deur kleinste antwoord.*
- Ratio/*Verhouding:* 3 : 8 : 3
- *Final answer/Finale antwoord:* $C_3H_8O_3$ ✓

6.1.3 5 ✓ (1)

6.1.4

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

$n = \frac{18}{137}$ ✓

n = 0,131 mol

$KMnO_4 : Mn_2O_3 = 2 : 1$
$n(Mn_2O_3) = 0,0656$ mol ✓

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

$0,0656 = \frac{m}{158}$ ✓

∴ m = 10,38 g ✓ (4)

Marking guidelines/*Nasienriglyne*
- Substitute 137 $g \cdot mol^{-1}$ in ratio/$n = \frac{m}{M}$. ✓
  Vervang 137 $g \cdot mol^{-1}$ in verhouding/$n = \frac{m}{M}$.
- Use ratio/*Gebruik verhouding:* $n(Mn_2O_3) = ½n(KMnO_4)$ ✓
- Substitute 158 $g \cdot mol^{-1}$ in ratio/$n = \frac{m}{M}$. ✓
  Vervang 158 $g \cdot mol^{-1}$ in verhouding/$n = \frac{m}{M}$.
- Final answer/*Finale antwoord:* 10,38 g ✓

6.2

6.2.1

Marking guidelines/*Nasienriglyne*
If any of the underlined key words/phrases are omitted: minus 1 mark
Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is: minus 1 punt

The amount of solute/dissolved substance per litre/dm^3 of solution. ✓✓
The hoeveelheid opgeloste stof per liter/dm^3 van die oplossing. (2)

6.2.2

$c = \frac{n}{V}$ ✓

$0,1 = \frac{n}{0,1}$ ✓

$n = 0,01$ mol ✓ (3)

6.2.3

$n(HC\ell) = \frac{V}{V_m}$ ✓

$= \frac{0,460}{24,45}$ ✓

$= 0,01881$ mol

↓

Ratio $HC\ell : NaC\ell = 1 : 1$

$n(NaC\ell) = 0,01881$ mol ✓

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

$0,0188 = \frac{m}{58,5}$ ✓

$m(NaC\ell) = 1,1$ g

↓

$\%purity = \frac{1,1}{1,5} \times 100$ ✓

$= 73,37\%$ ✓

Marking guidelines/*Nasienriglyne*

- Formula/*Formule*: $n = \frac{m}{M}$ / $n = \frac{V}{V_m}$ ✓
- Substitute 25,45 $dm^3 \cdot mol^{-1}$ in ratio/$n = \frac{V}{V_m}$. ✓
  Vervang 25,45 $dm^3 \cdot mol^{-1}$ *in verhouding/* $n = \frac{V}{V_m}$.
- Use ratio/*Gebruik verhouding*:
  $n(NaC\ell) = n(HC\ell)$ ✓
- Substitute 58,5 $g \cdot mol^{-1}$ in ratio/$n = \frac{m}{M}$. ✓
  Vervang 58,5 $g \cdot mol^{-1}$ in verhouding/ $n = \frac{m}{M}$.
- $\frac{m(\text{calculated / } bereken)}{m(\text{impure / } onsuiwer)} \times 100$ ✓
- Final answer/*Finale antwoord*: 73 g ✓

(6)
[24]

QUESTION 7/*VRAAG 7*

7.1

Marking guidelines/*Nasienriglyne*
If any of the underlined key words/phrases are omitted: minus 1 mark
Indien enige van die sleutelwoorde/frases uitgelaat is: minus 1 punt

The energy absorbed or released per mole in a chemical reaction. ✓✓
Die energie geabsorbeer of vrygestel per mol in a chemiese reaksie. (2)

7.2 Endothermic ✓
More energy is absorbed than released ✓ **OR** $\Delta H > 0$
Endotermies
Meer energie is geabsorbeer as vrygestel OF $\Delta H > 0$ (2)

7.3
7.3.1 544 (kJ/kJ·mol^{-1}) ✓✓ (2)

7.3.2 131 (kJ/kJ·mol^{-1}) ✓✓ (2)
[8]

QUESTION 8/*VRAAG 8*

8.1
8.1.1 An acid is a proton donor. ✓✓
'n Suur is 'n protonskenker. (2)

8.1.2 HNO_3 and/*en* NO_3^- ✓✓
OR/*OF*
H_2O and/*en* H_3O^+ (2)

8.1.3 Acidic/Suur ✓
Hydronium ions/H_3O^+ formed in water. ✓
Hidroniumione/H_3O^+ vorm in water. (2)

8.1.4

Marking guidelines/*Nasienriglyne*
If any of the underlined key words/phrases are omitted: minus 1 mark
Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is: minus 1 punt

An ampholyte is a substance that can act as either acid or base. ✓✓
'n Amfoliet is 'n stof wat as suur of basis kan optree. (2)

8.1.5 H_2O ✓

8.1.6 Reaction 1: It/H_2O reacts as base/accepts a proton or H^+. ✓
Reaction 2: It/H_2O reacts as acid/donates a proton or H^+. ✓ (2)

8.1.7

Marking guidelines/*Nasienriglyne*

- Substitute 0,1 dm^3 & 0,2 $mol \cdot dm^{-3}$ in formula/ratio. ✓
  Vervang 0,1 dm^3 & 0,2 $mol \cdot dm^{-3}$ in formule/verhouding.
- Use ratio/*Gebruik verhouding*:
  n(dilute/*verdun*) = n(concentrated/*gekonsentreerd*) ✓
- Substitute 0,02 mol & 0,16 $mol \cdot dm^{-3}$ in formula/ratio.
  Vervang 0,02 mol & 0,16 $mol \cdot dm^{-3}$ in formule/verhouding.
- Final answer/*Finale antwoord:* 0,025 dm^3 / 25 cm^3 ✓

OPTION 1/*OPSIE 1*

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

$0,2 = \frac{n}{0,1}$ ✓

∴ n(conc/*gekons*) = 0,02 mol
= n(dilute/verdun) ✓

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

$0,16 = \frac{0,02}{V}$ ✓

$V = 0,125\ dm^3$

Amount added/*Hoeveelheid bygevoeg*:
$0,125 - 0,1 = 0,025\ dm^3$ ✓

OPTION 2/*OPSIE 2*

$c_1V_1 = c_2V_2$
$(0,2)(100)$ ✓ $= (0,16)V_2$ ✓✓
$V_2 = 125\ cm^3$

Amount added/*Hoeveelheid bygevoeg*:
$125 - 100 = 25\ cm^3$ ✓

(4)

8.2

8.2.1

$c = \frac{n}{V}$ ✓

$0,16 = \frac{n}{0,08}$ ✓

$n = 0,0128$ mol

$n(ZnO) = \frac{1}{2}n(HNO_3)$
$= \frac{1}{2}(0,0128)$ ✓
$= 0,0064$

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

$0,0064 = \frac{m}{81}$ ✓

$m = 0,52$ g ✓

Marking guidelines/*Nasienriglyne*

- Formula/*Formule*: $n = \frac{m}{M}$ / $c = \frac{n}{V}$ ✓
- Substitute/*Vervang* 0,16 $dm^3 \cdot mol^{-1}$ & 0,08 dm^3 in $c = \frac{n}{V}$ /ratio/*verhouding* ✓
- Use ratio/*Gebruik verhouding*:
  $n(ZnO) = \frac{1}{2}n(HNO_3)$ ✓
- Substitute/*Vervang* 81 $g \cdot mol^{-1}$ in $n = \frac{m}{M}$ /ratio/*verhouding*. ✓
- Final answer/*Finale antwoord*:
  0,52 g ✓

(5)

8.2.2 Zinc nitrate/*Sinknitraat* ✓
$Zn(NO_3)_2$ ✓

(2)
[21]

QUESTION 9/*VRAAG 9*

9.1 A reaction in which electrons are transferred. ✓✓
'n Reaksie waar elektrone oorgedra word. (2)

9.2

9.2.1 +7 ✓ (1)

9.2.2 +2 ✓ (1)

9.3 Reduction/*Reduksie* ✓
The oxidation number decreased. ✓
Die oksidasie getal verminder.
OR
Electrons are gained./*Elektrone is opgeneem.* (2)

9.4 (Reaction/*reaksie*) 1 ✓

Oxidation number (of S) decreases ✓ from +4 (in SO_2) to 0 (in S).
Oksidaseigetal (van S) neem af van +4 (in SO_2) na 0 (in S).

OR/*OF*
SO_2 gains electrons./*SO_2 neem elektrone op.*
OR/*OF*
In reaction 2, the oxidation number (of S) increases from +4 (in SO_2) to +6 (in SO_4^{2-})./*In reaksie 2, neem die oksidasiegetal (van S) toe van +4 (in SO_2) na +6 in SO_4^{2-}).* (2)

9.5 $H_2S \rightarrow S + 2H^+ + 2e^-$ ✓✓

Marking guidelines/*Nasienriglyne*
- $H_2S \rightleftharpoons S + 2H^+ + 2e^-$ $\frac{1}{2}$ $S + 2H^+ + 2e^- \leftarrow H_2S$ $\frac{1}{2}$
  $S + 2H^+ + 2e^- \rightleftharpoons H_2S$ $\frac{0}{2}$ $S + 2H^+ + 2e^- — H_2S$ $\frac{0}{2}$
- Ignore if charge on electron is omitted./*Ignoreer indien lading op elektron uitgelaat is.*
- If charge on ion omitted e.g. $S + 2H + 2e^- \rightarrow H_2S$
  Indien lading op ion uitgelaat is bv. $S + 2H + 2e^- — H_2S$ Max/*Maks.* $\frac{1}{2}$

(2)

9.6 $H_2S \rightarrow S + 2H^+ + 2e^-$ (x2)
$SO_2 + 4H^+ + 4e^- \rightarrow S + 2H_2O$ ✓
$2H_2S + SO_2$ ✓$\rightarrow 3S + 2H_2O$ ✓ Bal. ✓

IF/*INDIEN*
No half-reactions shown/*Geen halfreaksies getoon nie:*
Max/*Maks.* $\frac{1}{2}$

(4)
[14]

QUESTION 10/*VRAAG 10*

10.1 Cyanide/CN^-/It is toxic. ✓
Sianied/CN^-/Dit is giftig. (1)

10.2 Basic/*Basies* ✓
Hydroxide is a base./*Hidroksied is 'n basis.*✓ (2)

10.3 +1 ✓ (1)

10.4 Au ✓ (1)

10.5 Oxidation/*Oksidasie* ✓ (1)

10.6 $Zn \rightarrow Zn^{2+} + 2e^-$ ✓✓

Marking guidelines/*Nasienriglyne*

- $Zn \rightleftharpoons Zn^{2+} + 2e^-$ $\frac{1}{2}$ $Zn^{2+} + 2e^- \leftarrow Zn$ $\frac{1}{2}$
  $Zn^{2+} + 2e^- \rightleftharpoons Zn$ $\frac{0}{2}$ $Zn^{2+} + 2e^- \rightarrow Zn$ $\frac{0}{2}$
- Ignore if charge on electron is omitted./*Ignoreer indien lading op elektron uitgelaat is.*
- If charge on ion omitted e.g. $Zn \rightarrow Zn + 2e^-$
  Indien lading op ion uitgelaat is bv. $Zn \rightarrow Zn + 2e^-$ Max/*Maks.* $\frac{1}{2}$

(2)

10.7 $\%Au = \frac{197}{272} \times 100$ ✓
$= 72,42\%$ ✓ (2)
[10]

TOTAL/*TOTAAL:* 150

GRAPH SHEET/*GRAFIEKPAPIER*

SUBMIT THIS GRAPH SHEET WITH THE ANSWER BOOK.
LEWER HIERDIE GRAGIEKPAPIER SAAM MET DIE ANTWOORDEBOEK IN.

NAME/*NAAM* _____ CLASS/*KLAS* _____

QUESTION/*VRAAG* 4.2

Graph of pressure versus inverse of volume
Grafiek van druk teenoor omgekeerde van volume