GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION /

GAUTENGSE DEPARTEMENT VAN ONDERWYS

PROVINCIAL EXAMINATION / *PROVINSIALE EKSAMEN*

JUNE/*JUNIE* 2016

GRADE / *GRAAD* 11

PHYSICAL SCIENCES P2/
FISIESE WETENSKAPPE V2

MEMORANDUM

12 pages / *bladsye*

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QUESTION 1: MULTIPLE-CHOICE QUESTIONS
VRAAG 1: MEERVOUDIGE KEUSE VRAE

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

[20]

QUESTION 2 / *VRAAG 2*

2.1 The average distance between the nuclei of two bonded atoms in a molecule ✓✓ (2)
Die gemiddelde afstand tussen die kerne van twee atome in 'n molekule wat aan mekaar verbind is ✓✓

2.2 161 pm✓✓ (2)

2.3 The energy that is required to break a bond✓✓
Die energie nodig om 'n binding te breek ✓✓ (2)

2.4 299 $kJ.mol^{-1}$ ✓✓ (2)

2.5 SHORTER THAN: ✓The H-Cl's bonds will be shorter than the H-I bonds as Cl is a smaller atom ✓and has lower bonding energy levels than Iodine.✓
KORTER AS: ✓Die H-Cl sal 'n korter binding hê as die H-I omdat die Cl atoom kleiner ✓is en oor minder bindings energievlakke as I beskik.✓ (3)

-Marking / - Merk

[11]

QUESTION 3 / *VRAAG 3*

3.1 A measure of an atom's attractive force on bonding electrons to form a molecule ✓✓ (2 marks or none)

'n Aanduiding van die atoom se aantrekkingskrag op die bindingselektrone wanneer 'n molekule gevorm word.✓✓ (2 punte of geen) (2)

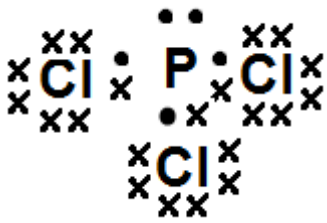
3.2 Oxygen has more protons / higher nuclear charge ✓in its nucleus and will thus have a stronger attraction on the bonding electrons. ✓ The outer energy level of nitrogen is just one electron less than that of oxygen. ✓

Suurstof het meer protone in sy kern / hoër kern lading ✓ en sal dus 'n sterker aantrekkingskrag op die bindingselektrone ✓hê terwyl stikstof se buitenste energievlak net een elektron minder as suurstof het. ✓ (3)

3.3.1 $C\ell_2$ ΔEN = 0 (same atom) pure covalent / non-polar ✓ (1 mark for both)
$C\ell_2$ ΔEN = 0 (dieselfde atoom) suiwer kovalent / nie-polêr ✓(1 punt vir albei)

H_2O ΔEN = 3,5 – 2,1 = 1,4 ∴ (strong) polar covalent ✓
H_2O ΔEN = 3,5 – 2,1 = 1.4 ∴ (sterk) polêr kovalent ✓
$PC\ell_3$ ΔEN = 3,0 – 2,1 = 0,9 ∴ (weak) polar covalent ✓
$PC\ell_3$ ΔEN = 3,0 – 2,1 = 0,9 ∴ (swak) polêr kovalent ✓ (3)

3.3.2



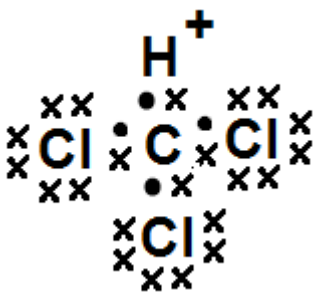
✓

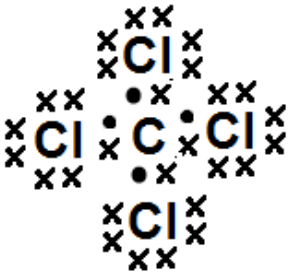
Trigonal pyramidal shape ✓
Trigonaal piramidaal

ΔEN = 3,0 – 2,1 = 0,9 ∴ weak/slightly polar covalent bonds
ΔEN = 3,0 – 2,1 = 0,9 ∴ swak/effens polêr kovalent binding ✓

Polar molecule – Chlorine ions all to one side and negative. (Asymmetrical)
Polêre molekule – die Chloor-ione almal aan die een kant is en negatief is. (Asimmetries) (3)

3.3.3





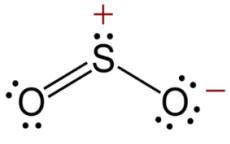
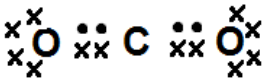
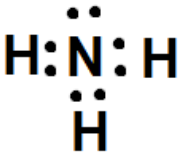
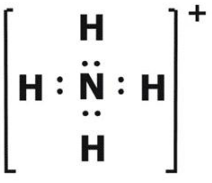
ΔEN C and Cl = 3,0 – 2,5 = 0,5 ∴ (weak/ slightly) polar covalent bonds
ΔEN C and Cl = 3,0 – 2,5 = 0,5 ∴ (swak/effens) polêr kovalente bindings

ΔEN C and H = 2,5 – 2,1 = 0,4 ∴ (weak/slightly) polar covalent bonds
ΔEN C and H = 2,5 – 2,1 = 0,4 ∴ (swak/effens) polêr kovalente bindings

All bonds are non-polar ✓ but the shape of the molecule, tetrahedral, ✓and the H^+ on the $CHC\ell_3$ makes it a polar molecule ✓while the symmetrical distribution of electrons on $CC\ell_4$ makes it a non-polar molecule.✓
Alle bindings is nie- polêr,✓ maar die vorm van die molekule is tetrahedraal,✓ en die H^+ op die $CHC\ell_3$ maak dit 'n polêre molekule✓ terwyl die simmetriese elektron verspreiding van CCl_4 dit 'n nie-polêre molekule maak.✓ (4)
[15]

QUESTION 4 / *VRAAG 4*

Don't accept van der Waals forces/
Moenie van Der Waals kragte aanvaar nie.

Substance	Lewis structure	Shape of the molecule using VSEPR theory	Intermolecular forces between the molecules
4.1 SO_2	4.1.1  ✓ **Charges not required / ladings nie noodsaaklik.**	4.1.2 Bent/ angular✓ *Gebuig/ hoekig*	4.1.3 Dipole-dipole✓ *Dipool-dipool*
4.2 CO_2	4.2.1  ✓	4.2.2 Linear ✓ *linieêr*	4.2.3 London / dispersion/induced dipole✓ *London/ dispersie/ geinduseerde dipool.*
4.3 NH_3	4.3.1  ✓	4.3.2 Trigonal pyramidal ✓ *Trigonaal piramidaal*	4.3.3 Hydrogen bonds✓ *Waterstofbindings*
4.4 NH_4^+	4.4.1  ✓	4.4.2 Tetrahedral ✓ *Tetrahedraal*	4.4.3 Hydrogen bonds✓ *Waterstofbindings*

(12)

4.5 Dative covalent / co-ordinate covalent bond ✓✓where the lone pair on one atom / molecule is shared by the empty orbital on another ion / atom / molecule.✓✓ **OR**
Dative covalent/co-ordinate covalent bond ✓✓is a covalent bond (a shared pair of electrons) in which both electrons come from the same atom.✓✓

Datief kovalente binding✓✓ waar 'n enkelpaar elektrone van een atoom deur 'n leë (onvoltooide) valensie energievlak van 'n ander atoom / ioon / molekule gedeel word. ***OF***
Datief kovalent binding ✓✓is 'n kovalente binding waar beide elektrone vanaf dieselfde atoom afkomstig is.✓✓ (4)

[16]

QUESTION 5 / *VRAAG 5*

Don't accept van der Waals forces/
Moenie van Der Waals kragte aanvaar nie.

5.1 He✓✓ (2)

5.2 5.2.1 (Weak) London / dispersion forces/ induced dipole force ✓✓
(Swak) London / dispersie kragte / geinduseerde dipool kragte ✓✓ (2)

5.2.2 (Strong) Hydrogen bonds ✓✓
(Sterk) Waterstofbindings✓✓ (2)

5.3 $CC\ell_4$ ✓✓ (**Accept:** Carbon tetrachloride **A*anvaar**: Koolstoftetrachloried*) (2)

5.4
HBr – Dipole-dipole forces ✓
HBr – dipool-dipool kragte ✓
H_2O – Strong Hydrogen bonds✓
H_2O – Sterk Waterstofbindings ✓
Dipole-dipole forces are weaker than Hydrogen bonds ✓therefore the melting and boiling point of water is higher than that of HBr ✓
OR:
Hydrogen bonds are stronger than Dipole-dipole forces ✓therefore the melting and boiling point of HBr is lower than that of H_2O ✓

Dipool-dipool kragte is swakker as Waterstofbindings.✓dus sal die sal die smelt en kookpunt van water hoër wees as die van HBr✓
OF
Waterstofbindings kragte is sterker as Dipool-dipool kragte.✓dus sal die sal die smelt en kookpunt van HBr laer wees as die van H_2O ✓
(4)

5.5 At -79° C carbon dioxide will turn from a solid straight into a gas✓✓
Teen -79° C sal die koolstofdioksied direk van 'n vastestof na 'n gas verander.✓✓ (2)
[14]

QUESTION 6 / *VRAAG 6*

6.1 **Boyle's Law**: ✓ The volume of an enclosed gas is inversely proportional to the pressure, provided that the temperature remains constant.✓✓
Boyle se wet. ✓*Die volume van 'n ingeslote gas is omgekeerd eweredig aan die druk daarop uitgeoefen, as die temperatuur konstant gehou word.*✓✓ (3)

6.2 6.2.1 Pressure ✓✓
Druk ✓✓ (2)

6.2.2 Volume ✓✓
Volume ✓✓ (2)

6.3 Temperature ✓/ *Temperatuur*✓
Amount / mass of gas/ ✓
Hoeveelheid/ massa gas ✓ (2)

6.4 **E.g**. How will the volume of a fixed amount of gas change if the pressure is increased while the temperature remains constant?✓✓

Question with only yes/ no answers, **no marks**]
<u>Criteria for marking:</u> The relationship between the dependent and independent variables must be mentioned in a question form and a question mark must be used at the end of the sentence.

Bv. *Hoe sal die volume van 'n konstante hoeveelheid gas beïnvloed word as die druk verhoog word terwyl die temperatuur konstant gehou word?* ✓✓

*[Vraag wat met ja of nee beantwoord kan word **geen punte**]*
<u>Merk kriteria:</u> Die verwantskap tussen die afhanklike en onafhanklike veranderlike moet in die vorm van 'n vraag aangespreek word en daar moet 'n vraagteken aan die einde van die sin wees.

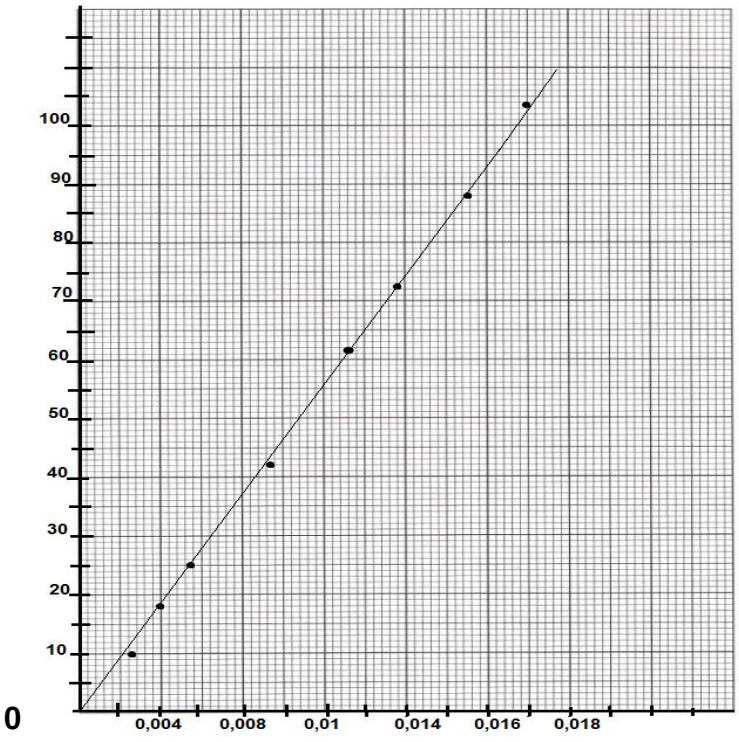
(2)

6.5

Pressure (kPa)	Volume (cm^3)	$\frac{1}{\text{Pressure}}$ (kPa^{-1})
62	103	0,016
70	88	0,014
80	73	0,0125
90	62	0,011
110	42	$9,09x10^{-3}$ / 0,00909
180	25	$5,56x10^{-3}$/ 0,00556
250	18	$4x10^{-3}$ / 0,004
360	10	$2,78x10^{-3}$ / 0,00278

✓

Volume vs Pressure / *Volume teenoor Druk*



Marking criteria:

Correctly labelled x- and y-axes with correct units✓
At least 5 points plotted correctly✓
Best fit line through origin ✓

Kriteria vir merk:

Korrekte x- en y-as benoeming met korrekte eenhede✓
Ten minste 5 punte korrek op grafiek ✓
Beste lyn getrek deur oorsprong ✓

QUESTION 7 / *VRAAG 7*

7.1
- Particles are in continuous motion in all directions. ✓
- Particles do not contribute to the volume of the gas. ✓
- There are no forces between the particles or the particles and the wall of the container, except during collisions. ✓
- Collisions are perfectly elastic with no loss of total energy of the molecules.
- All molecules are identical.
- The temperature of the gas is a measure of the average kinetic energy of the particles.
- Collisions of particles on the surface cause pressure.
- There is no motion and therefore no pressure at 0 K. 0 K is called absolute zero.

(ANY 3)

- *Deeltjies is in konstante in beweging in alle rigtings.* ✓
- *Deeltjies dra nie tot die volume van die gas by nie.* ✓
- *Daar bestaan geen kragte tussen die onderlinge deeltjies of tussen die deeltjies en die wande van die houer behalwe tydens botsings.* ✓
- *Botsings tussen deeltjies is volkome elasties met geen verlies aan totale energie van molekules nie.*
- *Alle molekules/ deeltjies is identies.*
- *Die temperatuur van die gas is 'n aanduiding van die gemiddelde kinetiese energie van die deeltjies.*
- *Botsings van deeltjies op die oppervlak veroorsaak druk.*
- *Daar is geen beweging en dus geen druk by 0 K. 0 K word ook absoluut zero genoem.* (3)

(ENIGE 3)

7.2 At **low** pressures✓ and **high** temperatures. ✓
*By **lae** druk ✓en **hoë** temperature*✓ (2)

7.3 The Kinetic theory of matter/ kinetic molecular theory ✓✓
Die Kinetiese teorie van materie/ kinetiese molekulêre teorie✓✓ (2)

7.4 $\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$ ✓

$\frac{(150)(5)}{(273+10)}$ ✓ = $\frac{(101,3)V_2}{(273+25)}$ ✓

$V_2 = 7,796$

$V_2 = 7,80\ cm^3$ ✓

$\frac{750}{283} = \frac{101,3V_2}{298}$ ✓✓

$223500 = 28583V_2$

$V_2 = 7,82\ cm^3$ ✓

(4)

7.5.1 $pV = nRT$ ✓

$(285 \times 10^3)(12 \times 10^{-3})$✓ = n (8,31)(273+55)✓

$V = 12 \div 1000 = 12 \times 10^{-3}$ m^3
$T = 273 + 55 = 328$ K
$p = 285 \times 10^3$ Pa

$$n = \frac{(285 \times 10^3)(12 \times 10^{-3})}{(8,31)(273+55)}$$

3420 = 2725,68n

$$n = \frac{3420}{2725,68}$$

n = 1,25 mol ✓ (4)

7.5.2 $n = \frac{m}{M}$ ✓

$1,25 = \frac{35}{M}$ ✓

M = 28 $g \cdot mol^{-1}$✓ (27,89 $g.mol^{-1}$) (3)

7.5.3 N_2 (g) / Nitrogen / *stikstof* ✓✓ (2)

7.6 Standard temperature and pressure ✓✓
Standaard temperatuur en druk✓✓ (2)

7.7 At STP 1 mole of any gas will occupy 22,4 dm^3 ✓
By STD sal 1 mol van enige gas 22,4 dm^3 volume beslaan ✓

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

$V = 3(22,4)$ ✓

V = 67,2 dm^3 ✓ (3)

7.8 $n = \frac{V}{V_m}$ ✓

$V = 5,4(22,4)$ ✓

V = 120,96 dm^3 ✓ (3)

[28]

Accept: Other methods as long as it is scientifically correct and get to the same answer
Aanvaar: *Ander metodes solank dit wetenskaplik korrek en dieselfde antwoord is.*

QUESTION 8 / *VRAAG 8*

8.1.1 Assume it's a 100 g sample: *Aanvaar dit is 'n 100 g monster.*

	C	**H**	**O**	
	76,60%	12,05 %	11,35%	✓
∴	76,60 g	12,05 g	11,35 g	
	$\frac{76,60}{12}$	$\frac{12,05}{1}$	$\frac{11,35}{16}$	✓
	6,38	12,05	0,709	✓
	0,709	0,709	0,709	
	8,99	16,99	1	
	9	17	1	

∴ empirical formula / *empiriese formule*: $C_9H_{17}O$ ✓✓ (5)

8.1.2 M = 141g·mol^{-1} [9(12)+17(1)+(16)]
∴ if Molecular mass is 282 g·mol^{-1} ÷ 141 = 2 times ✓✓
∴ *as Molekulêre massa 282 g·mol^{-1} is ÷141 = 2 keer*

2 x $C_9H_{17}O$ ∴ molecular formula/ *molekulêre formule*
= $C_{18}H_{34}O_2$ ✓✓ (4)

8.2.1 3 Fe ✓ + 4 H_2O ✓ → Fe_3O_4 + $4H_2$✓ (3)

8.2.2

	3Fe +	**$4H_2O$ →**	**Fe_3O_4**	**+ $4H_2$**
Mol ratio	**3**	**4**	**1**	**4**
Initial mol: *Aanvanklike mol* n = $\frac{m}{M}$ ✓	=14,5/56 = 0,259 =0,26 ✓	= 12/18 = 0,667 =0,67 ✓	0	0
Change in mol *Verandering in mol*	0,259	0,346	0,086	0,346
Mole left *Mol oor*	0	0,323		

✓ using ratio / gebruik van verhoudings

The Fe is the limiting reactant ✓✓(as there is only 0,259 mol available. If all the H_2O had to react, 0,500 mole of Fe would be needed.)
Fe is beperkende reagens ✓✓(*omdat daar slegs 0,259 mol beskikbaar is. Indien al die H_2O gebruik moes word, sou 0,500 mol Fe benodig word.)* (6)

8.2.3 0,086 mole Fe_3O_4 was formed / *is gevorm*

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

0,086 ✓= $\frac{m}{232}$ ✓

m = 232 x 0,086

= 19,95 g ✓ (3)

8.3 M of $CaCO_3$ = 100

1 mole $CaCO_3$: 1 mole CO_2 ✓

1 mol of gas = 22.4 litres at STP 22.4 litres of gas : 100 g $CaCO_3$ ✓

2.128 litres : 9.5 g✓

Percent purity / *Persentasie suiwerheid*: = 9.5/10 × 100 ✓= 95% ✓

(5)
[26]

QUESTION 9 / *VRAAG 9*

9.1 Density✓ / *Digtheid*✓ (1)

9.2 Boiling point ✓ When water is in liquid phase, it is more useful e.g. life, waterlife, bodyliquids, climate regulation✓
Kookpunt ✓Wanneer water in vloeistoffase is, is dit meer bruikbaar vir bv. lewe, waterlewe, liggaamsvloeistowwe, klimaatbeheer✓ (2)

9.3
- Specific heat ✓– amount of heat energy needed to increase the temperature of water ✓
- Absorption of infrared radiation✓ – absorbs heat from the sun and acts as heat reservoirs that regulate the climate of the earth. ✓
- High heat of vaporisation✓ – water can exist for a wider temperature range as a liquid and not evaporate. ✓
- *Spesifieke hitte ✓– hoeveelheid hitte energie wat benodig word om water se temperatuur te verhoog.* ✓
- *Absorpsie van Infrarooi straling ✓– absorbeer vanaf die son en tree as hitte reservoirs op wat die klimaat reguleer.* ✓
- *Hoë hitte van verdamping ✓– water kan oor 'n wyer temperatuur variasie as 'n vloeistof bestaan en nie verdamp nie.* ✓

Any 1 ✓✓/ *Enige 1*✓✓

(2)
[5]