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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 ŉ 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 ŉ 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 ŉ 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)

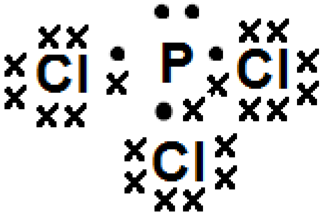
3.2 Oxygen has <u>more protons</u> / <u>higher nuclear charge</u> ✓in its nucleus and will thus have a <u>stronger attraction on the bonding electrons</u>. ✓ The outer energy level of nitrogen is just one electron less than that of oxygen. ✓

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

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

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

3.3.2



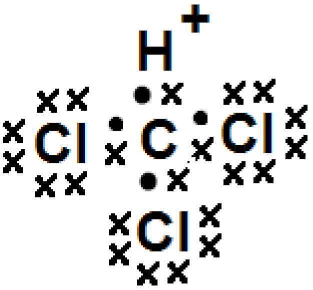
✓

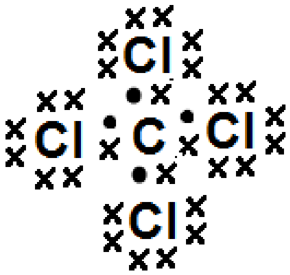
Trigonal pyramidal shape ✓
Trigonaal piramidaal

$\Delta EN = 3,0 - 2,1 = 0,9$ ∴ weak/slightly polar covalent bonds
$\Delta EN = 3,0 - 2,1 = 0,9$ ∴ 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

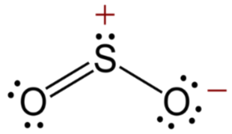
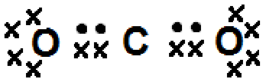
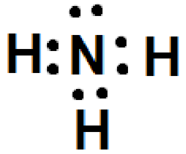
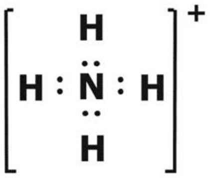
ΔEN C and H = 2,5 – 2,1 = 0,4 ∴ (weak/slightly) polar covalent bonds
ΔEN C and H = 2,5 – 2,1 = 0,4 ∴ (swak/effens) polêr kovalente bindings

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/ ✓ (2)
Hoeveelheid/ massa gas ✓

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.***

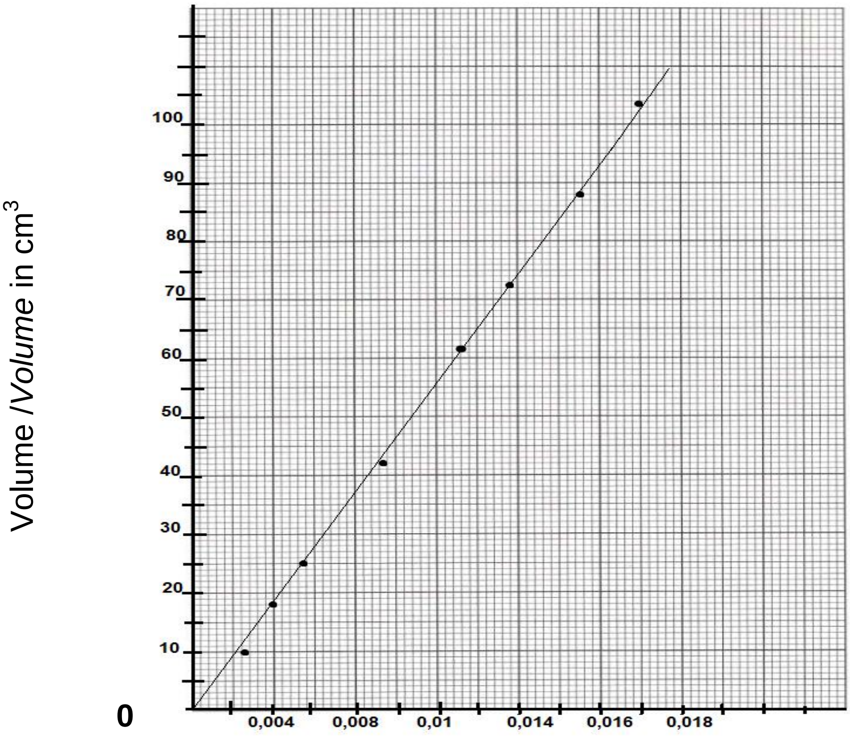
(2)

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	$9{,}09\times10^{-3}$ / 0,00909
180	25	$5{,}56\times10^{-3}$/ 0,00556
250	18	4×10^{-3} / 0,004
360	10	$2{,}78\times10^{-3}$ / 0,00278

✓

Volume vs Pressure / *Volume teenoor Druk*



$$\frac{1}{\text{Pressure}} / \frac{1}{Druk} (kPa^{-1})$$

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/ kineties 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 ÷ 1000 = 12 x 10^{-3} m^3
T = 273 +55 = 328 K
p = 285 x 10^3 Pa

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

n = 1,25 mol ✓

3420 = 2725,68n

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

(4)

7.5.2 $n = \frac{m}{M}$ ✓

$1,25 = \frac{35}{M}$ ✓

M = 28 g·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	
	$\frac{76,60}{12}$	$\frac{12,05}{1}$	$\frac{11,35}{16}$	✓
	$\frac{6,38}{0,709}$	$\frac{12,05}{0,709}$	$\frac{0,709}{0,709}$	✓
	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 +	**4H₂O →**	**Fe₃O₄**	**+ 4H₂**
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 Any 1 ✓✓/ *Enige 1*✓✓

- 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.* ✓

(2)
[5]